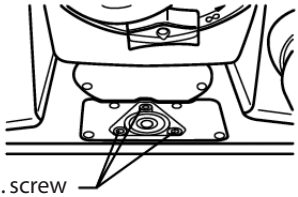
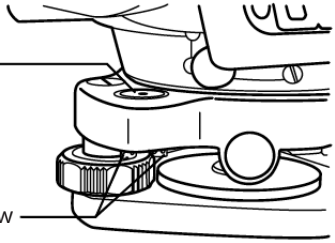


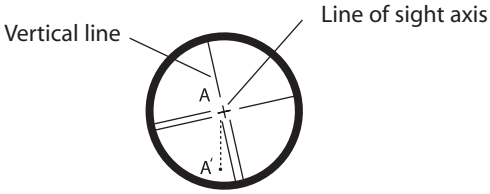


- Tighten the screws equally after the above adjustment.

10.3 Vertical reticle

[Checks]

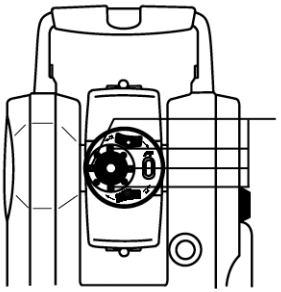
① Set the instrument up the tripod and carefully level it.
② Sight the target Point A with telescope.
③ Using the telescope fine adjustment screws, move Point A to the edge of the field of view by screw (Point A').
④ No adjustment is necessary if Point A moves along the vertical line of the reticle.



[Adjustments]

① If Point A is off from the vertical line of the reticle, first remove the eyepiece cover.
② Using the adjusting pin, loosen the four reticle adjustment screws slightly loosening each screw by the same amount, and then rotate the reticle line around the sight axis and align the vertical line of the sight axis with Point A'.
③ Tighten the reticle adjustment screws again by the same amount, and repeat the check to make sure the adjustment is correct.

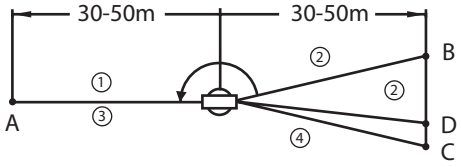
❊ Since the R-322NX,R-322EX,R-323NX and R-323EX have triple axis compensation, it is necessary to make other settings besides the adjustments mentioned above. For details, contact the dealers from whom the instrument was purchased.



10.4 Perpendicularity of line of sight to horizontal axis

[Checks]

① Position a target Point A at a distance 30m - 50m away from the instrument, and sight it with the telescope.
② Loosen the telescope lock screw and turn the telescope until a point is sighted at a distance roughly equal to that of Point A. This is Point B.
③ With the telescope still reversed loosen the horizontal lock screw and rotate the instrument around the vertical axis, and sight Point A again.
④ Loosen the telescope lock screw and turn the telescope until a point is sighted at a distance equal to that of Point B. This is Point C.
⑤ No adjustment is necessary if Point B and C are aligned.



[Adjustments]

① If Points B and C are not aligned, mark Point D at 1/4 the length of the BC, from Point C in the direction of Point B.
② Using the adjustment pin, rotate the reticle adjustment screws horizontally opposite each other (see preceding page), and move the reticle to sight Point D.
③ Repeat the check and make sure the adjustment is correct.

✻ Since the R-322NX, R-322EX, R-323NX and R-323EX have triple axis compensation, it is necessary to make other settings besides the adjustments mentioned above. For details, contact the dealers from whom the instrument was purchased.

10.5 Vertical 0 point error

Be sure to follow check procedures mentioned below after making adjustments on reticle and perpendicularity of line of sight to horizontal axis.

[Checks]

① Set up the instrument and turn the power on.
② Sight the telescope at any reference target A at Normal state. Read the vertical angle (y).
③ Turn the telescope and rotate the alidade. Sight the same target A again at Back state and read the vertical angle R.
④ Ify+R = 360°, no further adjustment is necessary.

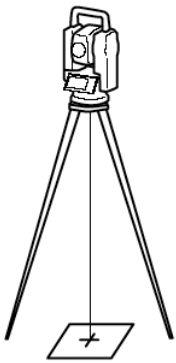
[Adjustments]

If the deviation d (y+ R - 360°) is wide, contact your local dealer.

10.6 Laser plummet

[Checks]

① Set the instrument on the tripod, and place a piece of white paper with a cross drawn on it right under the instrument.
② Press the [LASER] key, and move the paper so that the intersecting point of the cross comes to the center of the laser mark.
③ Rotate the instrument around the vertical axis, and observe the center mark position against the intersecting point of the cross at each 90° rotation.
④ If the laser mark always coincides with the intersecting point, no adjustment is necessary.



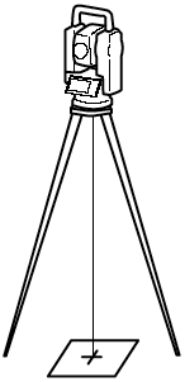
[Adjustments]

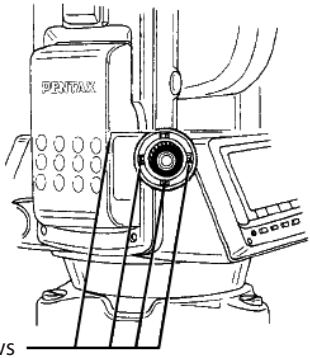
When a center part where a cross intersection and the laser mark look the brightest shifts by 0.8mm or more (at the instrument height 1.5m), it is necessary to adjust it.
A repair engineer does this adjustment. Please contact the PENTAX dealer.

10.7 Optical plummet

[Checks]

① Set the instrument on the tripod, and place a piece of white paper with a cross drawn on it right under the instrument.
② Look through the optical plummet, and move the paper so that the intersecting point of the cross comes to the center of the field of view.
③ Adjust the leveling screws so that the center mark of the optical plummet coincides with the intersecting point of the cross.
④ Rotate the instrument around the vertical axis. Look through the optical plummet each 90° of rotation, and observe the center mark position against the intersecting point of the cross.
⑤ If the center mark always coincides with the intersecting point, no adjustment is necessary.





Adjusting screws

[Adjustments]

① If the center mark does not coincide with the intersecting point, rotate the optical plummet focusing knob cover and remove it.
② Mark the point set on the line of sight at each step of 90° on the white paper and call them A, B, C and D.
③ Join the opposed points (A, C and B, D) with a straight line, and set the intersecting point 0.
④ Turn the four optical plummet adjusting screws with a adjusting pin so that the center mark coincides with the intersecting point 0.
⑤ Repeat from ④ and check that adjustment is correct.

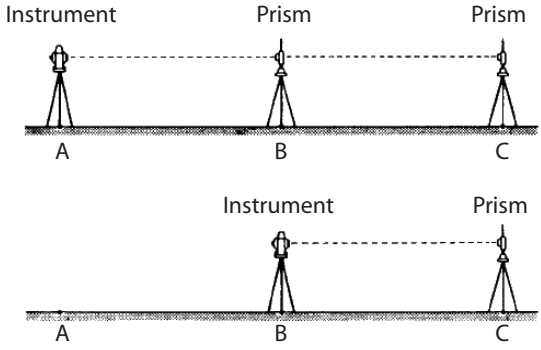
10.8 Offset constant

The offset constant rarely changes. It is recommended, however, that check be done once or twice a year.
The check of the offset constant can be done on a certified base line. It can also be obtained in a simple way as described below.

[Checks]
① Locate points A, B and C at about 50m intervals on even ground.
② Set up the instrument at point A, and measure the distances between AB and AC.
③ Set up the instrument at point B, and measure the distance BC.
④ Obtain the offset constant (K):

K=AC - (AB+BC)

[Adjustments]
- Contact your local dealer for adjustment of the off-set constant when the K is not nearly 0.



10.9 Beam axis and line of sight

Be sure to check that the beam axis and line of sight are aligned when the adjustments on reticle and perpendicularity of line of sight to horizontal axis are made.

[Checks]
① Set the prism at a distance greater than 50m.
② Accurately sight the center of the prism through the telescope.
③ Turn the power on and press (MEAS) to measure.
④ No adjustment is necessary if beam receiving buzzer sounds immediately and measurement value is displayed in a few seconds.

[Adjustments]
- If instrument function is not as described in ④, contact your local dealer.
- This check should be done under good weather conditions.

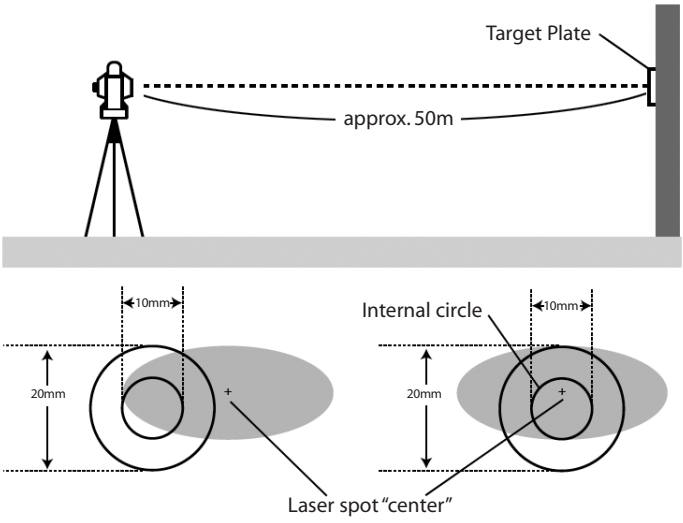
10.10 The EDM beam axis

The distance measurement (EDM) beam axis is adjusted to be aligned to the sighting axis of the telescope, but it can be changed a little in case of rapid temperature change, shock or aging. Check your instrument by following procedures.

[Checks]

① Install the instrument on the tripod and level it at the distance of approx. 50m from the wall.
② Displace the target plate attached to the end of this manual. Place the target plate adjusting its center to the center of telescope cross line and to be about horizontal to the instrument.
③ Turn the power on, and confirm the [TARGET] is set to the reflecting sheet mode ("S" will be indicated at the top of display, left side of the battery remains sign when it is that.) When it is not, press [F2] [TARGET] and set to eflecting sheet mode (Reference p39 - 6.1 Target setting).
④ Press [F1] [MEAS], then the laser spot appears on the target plate. If the "Center" of the laser spot is within the internal circle (10mm) of the target plate at this moment, the adjustment is unnecessary.

- The laser spot disappears in approx. 20 seconds after pressing [F1][MEAS]. Press [MEAS] again, if it is necessary.



[Example: Adjustment is necessary] [Example: Adjustment is unnecessary]

[Adjustments]

At the procedure 4. above, if the "Center" of laser spot is not within the internal circle (10mm) of the target plate, the adjustment is necessary. Please contact your PENTAX dealer.

11. SPECIFICATIONS

Reflectorless items are applicable to "NX" models only.

	R-322NX R-322EX	R-323NX R-323EX	R-325NX R-325EX	R-335NX R-335EX	R-315NX R-315EX	R-326EX
Telescope						
Image	Erect					
Optical aperture	45mm					
EDM aperture	45mm					
Reticle illumination	Intensity settings: 10 steps					
Auto&Power focus	Yes					No
Method	Phase differential					-
Power	By main battery					-
Pointer	Visible la ser					
Magnification	30 x					
Resolving power	3"					
Field of view	2.6% (1° 30')					
Minimum focus	1.0m					
Auto-Focus	Auto-focus / Power Focus / Manual					Manual
Distance measurement						
Laser Class	Visible Laser: Class II (2) / Class IIIa (3R) - long range mode in Reflectorless ("NX" models only)					Visible Laser: Class II (2)
Measurement range (Good condition)						
Reflectorless	1.5m -Normal range mode: 90m / long range mode 200m ("NX" models only)					-
Reflector sheet	1.5m - 600m (800m)					
Mini prism	1.5m - 1100m (1600m)					
1P	1.5m - 3400m (4500m)		1.5m - 3000m (4000m)			1.5m - 2000m (2800m)
3P	200m - 4500m (5600m)		200m - 4000m (5000m)			200m - 2800m (3500m)
Accuracy						
Prism Reflector Sheet	±(2+2ppm x D)mm					±(3+2ppm x D)mm
Reflectorless	±(5+2ppm x D)mm		±(5+3ppm x D)mm			-
At Auto-Atm Correction	Prism, Ref.sheet: ±(2+10ppm x D)mm / Reflectorless: ±(5+10ppm x D)mm ("NX" models only)					±(3+10ppm x D)mm
Measuring time						
Repeat meas.	Normal: Prism, Ref.sheet 2.0sec. (1mm) Track: Prism, Ref.sheet 0.4 sec. (1cm)			Normal: Prism, Ref.sheet 1.2sec. (1mm) *Quick mode		
Initial meas.	Normal: Reflectorless 2.3sec. (1mm) ("NX" models only)			Normal: Prism, Ref.sheet 2.5sec. (1mm) *Quick mode		

	R-322NX R-322EX	R-323NX R-323EX	R-325NX R-325EX	R-335NX R-335EX	R-315NX R-315EX	R-326EX
Angle measurement						
Measuring method	Absolute rotary encoder					
Detection	2 sides					
Minimum count	1″ (2cc) / 5″ (10cc) selectable					
Accuracy (ISO 17123-3)	2″	3″	5″			6″
Compensator	Triple axis		Dual axis			
Tangent screw	2 speed		1 speed			
Sensitivity of vials						
Plate level (electronic)	30″/1div.					
Circular level	8′/2mm					
Plummet	Visible Laser, ±0.8mm (instrument height 1.5m)					
Base	Detachable			Shifting	Fixed	Detachable
Dust and Water protection	IP56					
Ambient temperature	-20℃ ~ +50℃ / -4℉ ~122℉ (Working range)					
Tripod thread	5/8″ x 11			35mm x 2		5/8″ x 11
Dimensions/Weight						
Instrument	177(W) x 343(H) x 177(L)mm					
Weight (incl. Battery)	5.7 kg			5.5 kg	5.7 kg	
Carrying case	268(W) x 442(H) x 465(L) mm/3.9kg					
Battery pack BP02						
Power source	Ni-MH (Rechargeable)(4300mAh), DC6V					
Operation time	Continuous Approx. 5 hrs (ETH+EDM),12 hrs (ETH) with Approx. 2.2 hrs of charging time					
Weight	Approx. 380g					
Charger BC03 and AC Adapter AC01						
Input voltage	AC 100~240V (AC01)					
Output voltage	DC7.5V (BC03)					
Weight	280g					
Internal Memory						
Coordinates data	20000 points		16000 points			12000 points
Clock Date						
NX MODEL	Yes		Yes			-
EX MODEL	Yes		No			No

[Note]

- The measurement range may vary by measurement conditions.
- Normal conditions: 20km visibility with slight shimmer.
- Good conditions: 40km visibility, overcast, no heat, no shimmer and moderate wind.
- Reflector sheet: PENTAX genuine reflector sheet (5cm x 5cm).
- Quick Mode, wich is effective only under Normal mode (1mm) setting, functions with Prism and Reflectorless Sheet. It is incorporated in all X series models and effective up to 500m.
- When Quick Mode is on, the EDM accuracy using prism and reflector sheet is ±(3+2ppm x D)mm. When automatic correction is activated in Quick Mode, the EDM accuracy is ±(3 +10ppm x D)mm.
- EDM Measuring time varies according to distance to be measured and conditions of the environment.
- Reflectorless:
  - The measurement range and accuracy of Reflectorless are based on the condition that laser beam is emitted perpendicular to the white side of the Kodak Gray Card.
  - The measurement range may be influenced by the shape of the target and its environment.
  - The measurement range at TRACK mode is over 5m.
- The operating time becomes shorter under the low temperature, due to the temperature dependence of the battery performance.
- The points that can be recorded in one job file are maximum 2,000 measuring points (XYZ). The user can make up to 50 job files. Job history can be managed thanks to date clock recorded in each job file.

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12. DATA COLLECTOR

The instrument can communicate directly with a computer through the RS232C interface. By use of a data collector you can automate data entry from the collection of survey data to the transfer of the data to a computer. This is useful in saving time and protecting data integrity.

About connection with data collector and the handling, please refer to an "Instruction manual" of the data collector.
Connecting a data collector to a computer is different with every system.
Please contact your local dealer about them.

13. APPENDIX

13.1 Error messages

Warning Message	Meaning	What to do
Out of tilt range	Displayed when the instrument is tilted beyond the vertical compensation range (±3′) in case 1 axis or 2 axis automatic compensation is selected. This message may be temporarily displayed if the instrument is turned too fast.	Re-level the instrument. Repair is needed if the message is displayed when it is properly leveled.
Excess data	The input data exceeds the allowable range.	Press the [ESC] key and enter the correct data.
Mismatched Target	• This message is displayed if a long distance which is a far beyond measurable distance of R-300X series is measured with a wrong target mode. Please select a correct target then measure. If a wrong target is selected, a correct distance cannot be measured.	Select the correct target mode.
Target is too close.	• The measurement distance is less than 1.5m in Reflector sheet mode. • The measurement distance is less than 1.5m in Prism mode.	Select a longer point, or use a tape measure.
Unsuitable Condition	• Under too strong sun light. • Unstable light value owing to shimmer or obstacles. • Reflector sheet, Target and Prism do not face the instrument. • Reflector sheet, Target and Prism are not correctly sighted. • Measurement range is over in Reflectorless mode. • Sufficient signal does not return by sighting sharp edge etc. at Reflectorless mode.	Change the object that has much better reflectivity, or use a reflecting sheet, or wait until the sun activity has weakened.
Li-batt.voltage is low.	• The Date Clock is powered by the built-in lithium battery. • The lithium battery needs to be replaced in five years.	Have the lithium battery replaced by the dealer from whom the instrument was purchased.

Error Message	Meaning	What to do
ERROR!! EDM ERROR 04 -05, 34-39, 50-53	Distance measurement system problem	Turn the power off, and then turn on again. Repair is needed when the message appears consistently.
ERROR!! ETH ERROR 70-76	Angle measurement system problem	
ERROR!! MEMORY ERROR 19	Memory problem	
ERROR PS DATA of EDM ERROR P DATA of EDM	Problem of the internal EDM parameters	
ERROR ETH DATA	Problem of the internal ETH parameters	

13.2 Atmospheric Correction

The speed at which light travels through the air varies depending on the temperature and atmospheric pressure. The R-300X series is designed to measure distances at the speed of light in order to measure accurately, atmospheric correction needs to be used. The instrument is designed to correct for weather conditions automatically if the temperature and pressure are input. Correction is then carried out based on the following formula.

Calculation formula:

$$K = (276.26713 - \frac{78.565271 \cdot P}{273.14941 + t}) \times 10^{-6}$$

K: Atmospheric Correction Constant
P: Atmospheric pressure (hPa)
t: Temperature(℃)
Distance after Atmospheric Correction D = Ds (1+K)
Ds: Measured distance when no Atmospheric Correction is used.

13.3 hPa and mmHg conversion table

[Converting from hPa to mmHg]

hPa	0	10	20	30	40	50	60	70	80	90
	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg	mmHg
500	375	383	390	398	405	413	420	428	435	443
600	450	458	465	473	480	488	495	503	510	518
700	525	533	540	548	555	563	570	578	585	593
800	600	608	615	623	630	638	645	653	660	668
900	675	683	690	698	705	713	720	728	735	743
1000	750	758	765	773	780	788	795	803	810	818
1100	825	833	840	848	855	863	870	878	885	893
1200	900	908	915	923	930	938	945	953	960	968

[Converting from mmHg to hPa]

mmHg	0	10	20	30	40	50	60	70	80	90
	hPa	hPa	hPa	hPa	hPa	hPa	hPa	hPa	hPa	hPa
400	533	547	560	573	587	600	613	627	640	653
500	667	680	693	707	720	733	747	760	773	787
600	800	813	827	840	853	867	880	893	907	920
700	933	947	960	973	987	1000	1013	1027	1040	1053
800	1067	1080	1093	1107	1120	1133	1147	1160	1173	1187
900	1200	1213	1227	1240	1253	1267	1280	1293	1307	1320

13.4 Error when no atmospheric correction is made

When measurement is carried out with no atmospheric correction (with the settings fixed at a temperature of 15°C and an atmospheric pressure of 1013hPa or 760mmHg), the error per 100 meters in temperature and pressure will be shown in the tables below.

- When the actual pressure is 1013hPa (760mmHg) and the temperature is 25°C, conducting the measurement with the temperature left at 15°C will result in the measurement being short by 0.9mm per 100 meters.

[Error table: When hPa (15°C, 1013hPa as standard)]

Unit: mm

C° \ hPa	1200	1100	1013	900	800	700	600	500
45	2.0	-0.5	-2.6	-5.5	-8.0	-10.5	-13.0	-15.5
35	3.0	0.4	-1.8	-4.7	-7.3	-9.9	-12.5	-15.1
25	4.0	1.4	-0.9	-4.0	-6.6	-9.3	-12.0	-14.6
15	5.2	2.4	-0.0	-3.1	-5.9	-8.6	-11.4	-14.2
5	6.3	3.5	1.0	-2.2	-5.1	-8.0	-10.8	-13.7
-5	7.6	4.7	2.1	-1.3	-4.2	-7.2	-10.2	-13.1
-15	9.0	5.9	3.2	-0.2	-3.3	-6.4	-9.5	-12.6

[Error table: With mmHg (15°C, 760mmHg as standard)]

Unit: mm

mmHg / C°	900	800	760	700	600	500	400
45	2.0	-1.3	-2.6	-4.6	-8.0	-11.3	-14.6
35	3.0	-0.4	-1.8	-3.9	-7.3	-10.8	-14.2
25	4.0	0.5	-0.9	-3.1	-6.6	-10.2	-13.7
15	5.2	1.5	0.0	-2.2	-5.9	-9.6	-13.3
5	6.3	2.5	1.0	-1.3	-5.1	-8.9	-12.7
-5	7.6	3.7	2.1	-0.3	-4.2	-8.2	-12.2
-15	9.0	4.9	3.2	0.8	-3.3	-7.4	-11.5

13.5 Atmospheric refraction and earth curvature correction

- Atmospheric refraction and earth curvature correction refers to correcting both the bending of the light beam caused by atmospheric refraction and the effect on the height differential and horizontal distance caused by the earth curvature.
- Correction called "atmospheric refraction and earth curvature correction" is initiated to correct error when the slope distance and vertical angle are caused to determine the horizontal distance and the height differential, with this instrument, the following formula is used to correct these factors.
- Calculation formula when atmospheric refraction and earth curvature correction parameter is set to "ON":

Corrected horizontal distance (H)

$$H = S\left(\cos\alpha + \sin\alpha \cdot \frac{K-2}{2Re} \cdot S \cdot \cos\alpha\right)$$

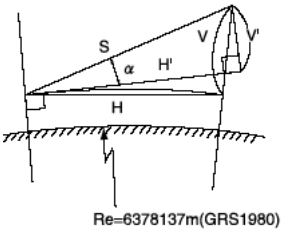
Corrected vertical distance (V)

$$V = S\left(\sin\alpha + \cos\alpha \cdot \frac{1-K}{2Re} \cdot S \cdot \cos\alpha\right)$$

- Calculation formula when atmospheric refraction and earth curvature correction parameter is set to "OFF":

Horizontal distance	$H' = S \cdot \cos\alpha$
Vertical distance	$V' = S \cdot \sin\alpha$

S: Slope distance
α: Vertical angle from horizontal
K: Atmospheric refraction coefficient (0.14 or 0.2)
Re: Diameter of earth (6,370 km)



13.6 Distance range

Generally speaking, the maximum range which can be measured varies considerably depending on the atmospheric conditions. For this reason, the specifications illustrate the values for both good and normal weather conditions.
It is extremely difficult to judge when weather conditions are "Good" and when they are "Normal". With this instrument, the conditions noted below are used to differentiate between the two situations, (good weather conditions for surveying are different from normal weather conditions, and in surveying situations, cloudy skies are considered more favorable than sunny skies.)

Weather conditions for measurement ranges are based on the following standard values:

Normal: Visibility of approximately 20 km, with slight shimmer and moderate wind.
Good: Visibility of approximately 40 km, overcast, with no shimmer and moderate wind.

14. NOTICE TO THE USER OF THIS PRODUCT

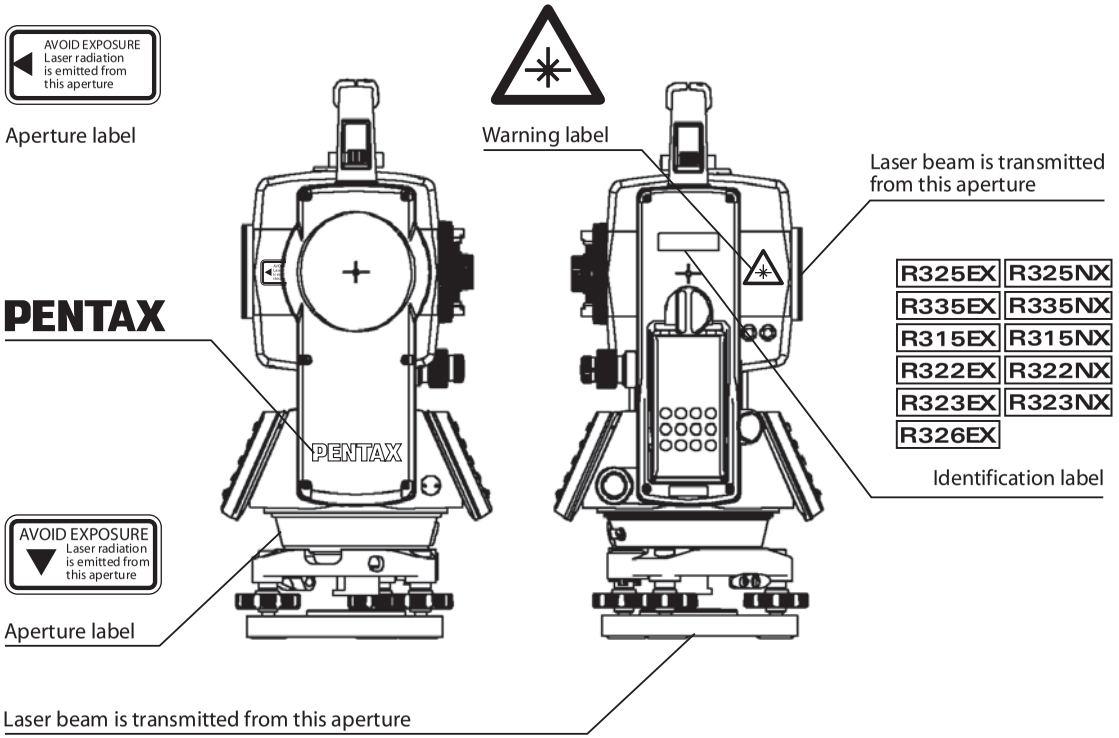
To assure compliance with the Safety standard 21 CFR, Chapter 1. Subchapter J.
The U.S. bureau of Radiological Health requires the following information to be provided to user:

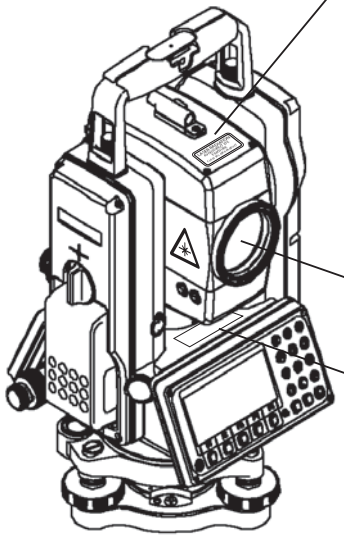

It can be dangerous to look into the beam with optical equipment such as binoculars and telescopes.

1) Specifications of laser radiation
   A) The EDM module of the R-300X produces a visible light beam, which is emitted from the telescope objective lens and the center hole of the instrument base plate. The R-300X is designed and built to have a laser diode radiating at 620-690 nm.
   B) Radiant power
   The R-300X is designed and built to radiate a maximum average radiant power of 4.75mw. (0.95mw for the model without "NX") from the telescope, and 0.95mw from the center hole of the base plate. The user may be subject to this radiation as a beam while operation until such time that the instrument is turned off.

2) The following labels are affixed to and must remain attached to this laser product.
   A) The following certification label is located near the plate level:
   "This laser product is complied with the provisions of 21 CFR 1040. 10 and 1040.11. For a Class II laser product."
   Or for R-300NX models:
   "This laser product is complied with the provisions of 21 CFR 1040. 10 and 1040.11. For a Class IIIa laser product."
   B) Caution label is located near the exit aperture :
   "AVOID EXPOSURE laser radiation is emitted from this aperture."
   C) Warning logotype is located on the surface of the telescope:
   "CAUTION LASER RADIATION DO NOT STARE INTO BEAM"
   Or for R-300NX models:
   "DANGER LASER RADIATION AVOID DIRECT EYE EXPOSURE"
   D) Warning label is located near the exit aperture.

3) Caution to maintain the safety in compliance with the standard
   A) To maintain the safety standard, refrain from any operation, maintenance, or adjustment other than described in this instruction manual.
   B) Operation, maintenance or adjustment other than those specified in this instruction manual may result in hazardous radiation exposure.
   C) Maintenance and repair not covered in this manual must be done by an authorized Pentax dealer.
   D) The laser beam emission by the distance measurement can be terminated by pressing F1 MEAS key.
   E) Pressing laser key ⇨ F2 LD POINT key can terminate the laser beam emission by the laser pointer.
   F) The laser beam emission by the laser plummet can be terminated by pressing laser key.


AVOID EXPOSURE
Laser radiation
is emitted from
this aperture
Aperture label
Warning label
Laser beam is transmitted
from this aperture
PENTAX
R325EX R325NX
R335EX R335NX
R315EX R315NX
R322EX R322NX
R323EX R323NX
R326EX
Identification label
AVOID EXPOSURE
Laser radiation
is emitted from
this aperture
Aperture label
Laser beam is transmitted from this aperture



Warning logotype

For R-300NX model

LASER RADIATION
AVOID DIRECT EYE EXPOSURE
CLASS 3R LASER PRODUCT

For R-300EX model

LASER RADIATION
DO NOT STARE INTO BEAM
CLASS 2 LASER PRODUCT

Laser beam is transmitted from this aperture

For North America Certification

For R-300NX model

PENTAX Industrial Instruments Co., Ltd.
2-5-2 Higashi Ozumi Nerima-ku. Tokyo 178-8555 Japan
This Laser product is complied with the provisions of 21 CFR 1040-10 and 1040-11 For a class IIIa product
ASSEMBLED BY PENTAX VN Co.LTD
Sai Dong B Industrial zone. Gia Lam. Hanoi Vietnam

For R-300EX model

PENTAX Industrial Instruments Co., Ltd.
2-5-2 Higashi Ozumi Nerima-ku. Tokyo 178-8555 Japan
This Laser product is complied with the provisions of 21 CFR 1040-10 and 1040-11 For a class II product
ASSEMBLED BY PENTAX VN Co.LTD
Sai Dong B Industrial zone. Gia Lam. Hanoi Vietnam

Warning logotype

For R-300NX model

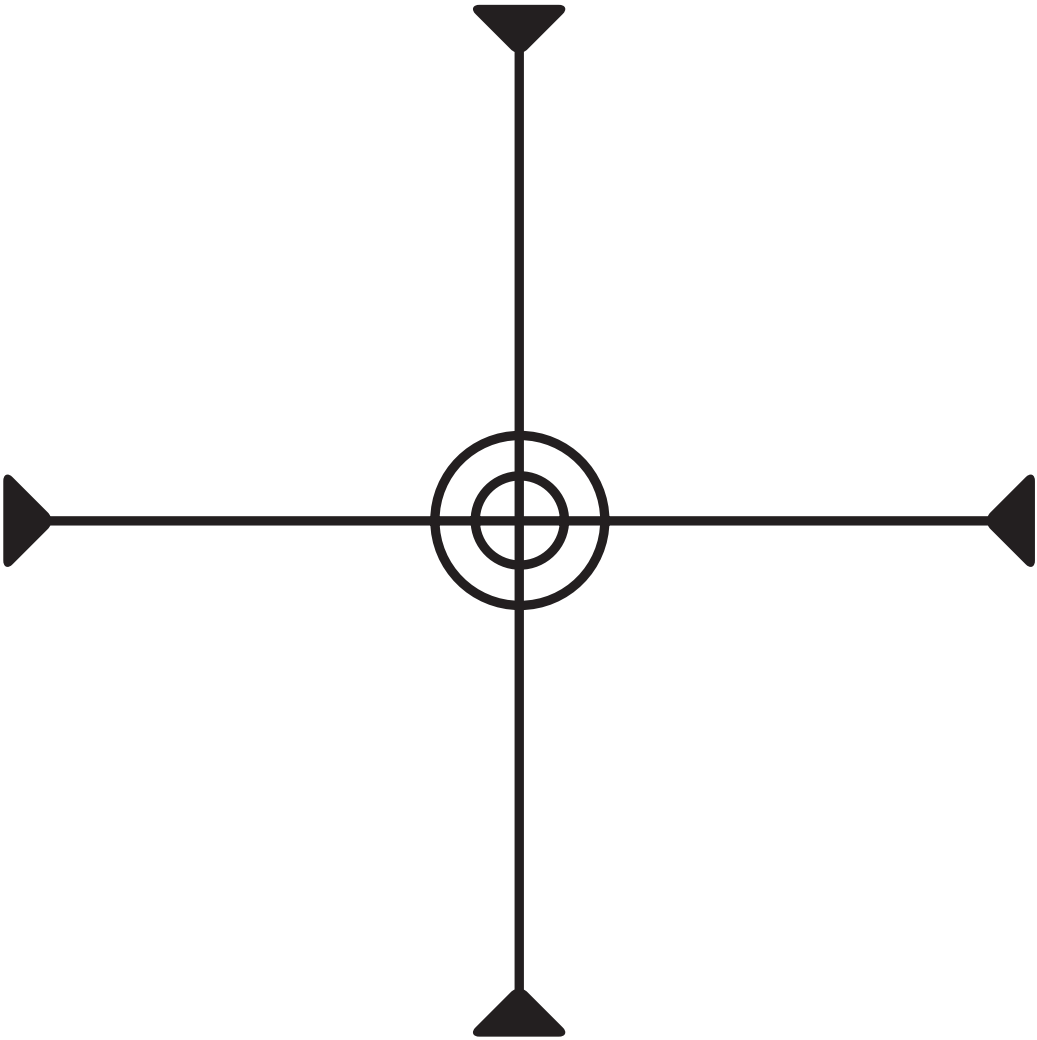
DANGER

For R-300EX model

CAUTION

LED is turned on at the time of emission

[TARGET PLATE]



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PENTAX

for your
precious moments

ISO
ISO 9001:2000
ISO 14001:1996

CE

The CE marking assures that this product complies with the requirements of the EC directive for safety.

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Japan Surveying Instruments Manufacturers' Association

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