UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
National Geodetic Survey
Corbin, Virginia 22446

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To : NGS Advisors and other interested parties

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Subject: Availability of 20 mm offset plugs for leveling and future availability of Temperature Gradient Thermistors Sets

20 mm plugs

Owing to a request from several geodetic advisors for 20 mm off-set plugs used in precise leveling, I was able to locate and contact the vender, Jobmaster Corporation, who had previously supplied NGS with these plugs. Unfortunately, the plugs are not an in-stock product and require tooling up to be produced. Before the company would tool-up, they required orders of at least 50 to 100 plugs. The price quoted would be $27.60 each.

After talking to Jobmaster, I contacted the people most interested in acquiring the plugs and informed them of the minimum order requirement and asked them to contact the company of there intent to buy. Apparently, enough orders were placed for the company to decide to make at least 100 or perhaps more.

This letter is to inform you that these plugs should be available in a few weeks. Jobmaster accepts most credit cards and purchase orders. You must order them directly. Contact the company at the following:

Jobmaster Corporation
9006-9010 Liberty Rd.
P.O. Box 207
Randallstown, MD 21133

Phone: (800)642-1400 or (410)655-1400
email: path@jobmaster.com

Ask for Pat, she's the person I have been dealing with. If she's is not available, others will also be able to take your order.

The plugs are:

Part/Item Number: A8630X787
Description: ALXIII 0.630"x0.787"

The plugs are precision made magnetic cylinders, 16 mm in diameter and 20 mm tall with the top and bottom surfaces flat and parallel. See below for more explanation on their use in precise leveling.

Temperature Gradient Thermistor Sets

In a conversation with, Dixon Hoyle, Minnesota Geodetic Advisor, he informed me that the Minnesota DOT were attempting to manufacture the aspirated temperature probes previously made here at the I&M Branch. It may be possible for them to manufacture sets for other user's. He will let me know when and if this is possible and what the cost may be. I will pass this info on as soon as I hear from Dixon.

More 20 mm Plug Information (from Digital Leveling User's Guide):

Setting the Rod on a Bench Mark

When setting the leveling rod on a bench mark disk, remove the footplate keeper and set the footplate directly on the disk making sure that the edges are not catching on any of the concrete around the disk. If nothing is catching, turn the rod side to side to find the high point on the disk. Once satisfied that the high point has been found, extend the brace poles and plumb the rod.

If a high point cannot be established or the footplate is catching on the concrete, it will be necessary to use the 20 mm offset plugs. These are machined magnetic plugs which are placed on the footplate of the leveling rod to lift it above an obstruction or establish a high point on a very flat disk with no definable high point. If the disk is flat, center the 20 mm plug in the center of the disk.

IMPORTANT NOTE!!! Always use the plugs in pairs. In other words, if it is necessary to use a 20 mm plug on a disk, be sure to put a plug on the other rod at the same time, otherwise, a 20 mm error will occur in the leveling. Just as important is removal of the plugs after the setup is completed. At this time, the I&M Branch has very few of these machined offset plugs, so take care not to lose them. Call the NGS I&M Branch for information about acquiring a set.

Once the plugs are in place, take the normal setup observations. Make a note on the field recording sheet whenever the 20 mm plugs are used. The plugs can also be used with the 60 CM invar strip (See - Appendix F).

APPENDIX F

LEICA 60 CM BAR-CODE INVAR SCALE (STRIP) AND ITS USE WITH THE LEICA DIGITAL LEVEL INSTRUMENTS (NA2000, NA2002, NA3000, NA3003)

LEICA 60 CM BAR-CODE INVAR SCALE (STRIP)
AND ITS USE WITH LEICA DIGITAL LEVEL INSTRUMENTS
(NA3000, NA3003, NA2000, NA2002)

The Leica 60 cm bar-code Invar strip provides the means to access some elevation points not accessible using the bar-code leveling rods. Before the strip can be used for conventional leveling, it has to be modified with the addition of a reference index. The design of the strip, as it comes from the factory, has the bar-code on one side and the height reference line on the other side. This may be ok for industrial use, but not for leveling. The following describes a design that was created at the National Geodetic Survey's Instrumentation and Methodologies Branch in Corbin, Va. for use with their NA3003 digital leveling systems.

The Invar strip is needed to run levels to bench marks set vertically in walls, foundations, bridge abutments, or locations where the level rod cannot be placed.

Fabricating and Attaching the Index (Drawing #1)

Three components are needed to modify the Invar strip for leveling:

1. the Invar strip as it comes from the factory
2. the Invar strip index, which will be fabricated
3. a screw to attach the index to the Invar strip

These components are depicted in the attached drawing labeled "Drawing #1". Fabricating the index will require the services of a machinist. The idea of the index is to provide a visible height reference point that can be observed when looking at the front (bar-code side) of the Invar strip. The index described in the following is a piece of machined steel attached to the Invar strip in a way that prevents it from moving or twisting and that has a bottom edge that extends the height reference line beyond the outer sides of the Invar strip.

The index should be machined from a piece of steel about 1x1½x¼ inches. Drawing #1 shows two dimensioned views of the index, a front view and a bottom view. The dimensions shown are approximate and for illustrative purposes only. The overall size of the index is not that critical. It should be wide enough to extend the bottom edge at least a quarter of an inch beyond the sides of the strip and tall enough to allow attachment to the strip using the existing hole when the bottom edge is aligned with the height reference mark. First, a **c** inch deep groove the width (about 1 inch) of the Invar strip is milled into the steel. The Invar strip should set snugly into the groove. This will prevent the index from twisting and keep the bottom edge parallel to the reference line. After the groove is cut and the bottom edge aligned with the reference line, use the existing hole near the bottom of the Invar strip as a guide and drill a hole for the attachment screw (See Drawing #1). By using this hole, no modification to the Invar strip itself is required. Use a screw size that fits the existing 3 mm (0.118 in) hole as tightly as possible to prevent the index from moving. Drill and tap the hole in the index to match the screw. The remaining milling on the index is to outline the tabs. Remember, the important thing is that the bottom edge of the tabs on the index are aligned with the reference line on the back of the strip.

Checking Index Location (Drawing #2)

After fabricating and attaching the index to the Invar strip, it is necessary to check the location of the index to assure that it will provide the correct height reading. Find a stable elevated point at about the height (5.5 ft) of the level instrument onto which both the Invar strip and a level rod can be set (See Drawing #2). Set

up the level instrument 10-13 meters away and hold the Invar strip on the point using either the left or right tab and plumb the strip. Take several sets of height measurements and record the heights. Without moving the level, do the same for the other tab. Next, again without moving the level, set the level rod on the point, plumb and take several measurements. If the index is correctly attached to the Invar strip, all of the height readings should be very close, a tenth or hundredths of millimeters. If not, redo the test and, if necessary, adjust or modify the index so readings will be correct.

USING THE INVAR STRIP (Drawings #3 and #4)

As stated earlier, the 60 cm bar-code invar strip is needed to establish elevations on points or marks that cannot be accessed using a standard leveling rod, such as, bench marks set vertically in foundations, bridge abutments, etc., or special elevation points required by a given survey. The index described above was designed primarily for vertically set bench marks, so it may not work for all situations.

Drawing #3 depicts using the invar strip on a vertically set bench mark disk. The 60 cm bar-code invar strip can only be observed at a distance of 20 meters or less. To use the invar strip on a vertically set bench mark, first find the point on the BM disk that will be leveled to, which on a standard NGS disk is the intersection of the horizontal line and shorter vertical line cast at the center of the disk. Hold the invar strip up the mark with the reference index close to the reference line on the disk. Set up the level instrument less than 20 meters away and at a height where when the line of sight of the leveled instrument intersects the invar strip about in the middle. Two people should hold the invar strip, one at the top to keep it plumb and one at the bottom to align the index to the mark. The strip can be plumbed in several ways:

1. By observing it through the instrument and aligning the left or right edge of the strip with vertical reticle line of the instrument.

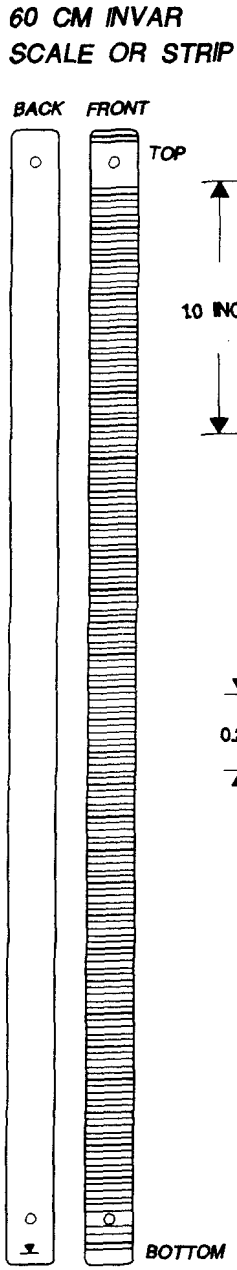
2. Use a carpenters level held up to the side of the strip.

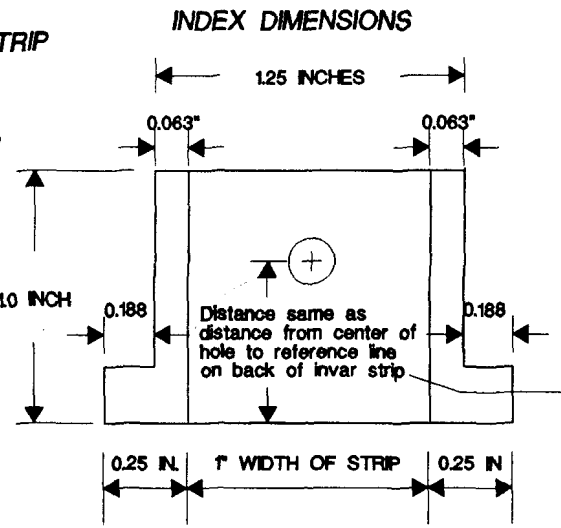
3. Use a handheld level bubble.

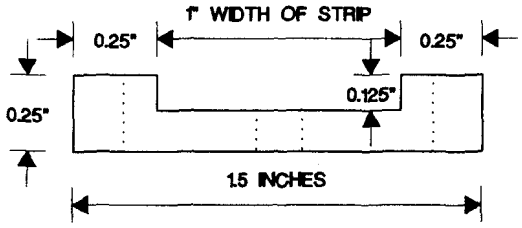
When near plumb, have the person at the bottom of the strip align the bottom of one of the index tabs with reference line on the disk (See Drawing #3). Once assured the index is aligned correctly, the top person check the plumb. If all is correct, press the measure button on the level and take the measurements. Note: The invar strip can also be read in an inverted or upside down position as can the level rods. The instrument, however, must be set for inverted readings. REMEMBER, always reference measurements to the bottom edge of the index tabs, plumb the invar strip and never use the bottom edge of the invar strip as a reference line.

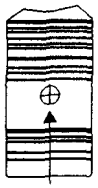
To use the invar strip on a horizontally set bench mark or elevation point, it may be necessary to use a spacer ("plug"). NGS uses calibrated metal 20 mm cylinders (See Drawing #4). Some spacers are magnetic so that they will stick to the steel footplate of a level rod. The spacers are most always used in pairs, one on the backsight rod and the other on foresight rod or invar strip. They raise the rod and invar strip equal amounts so that the difference of elevation between backsight and foresight remains correct. Remember to remove them before reading the next setup. If one is left on, an error, the height of the spacer, will be introduced into the level observations on the next setup. If only one spacer is available, place it first on the backsight rod and take the level measurements, then move it to the foresight and take the measurements.

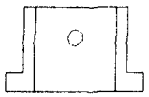
REFERENCE INDEX FOR LEICA 60 CM INVAR STRIP

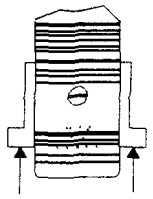


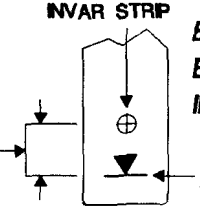


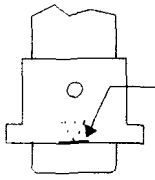


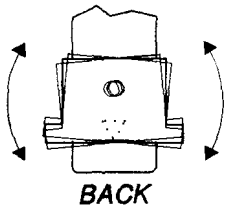




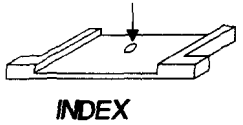




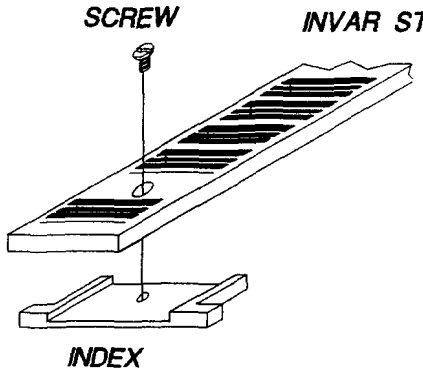


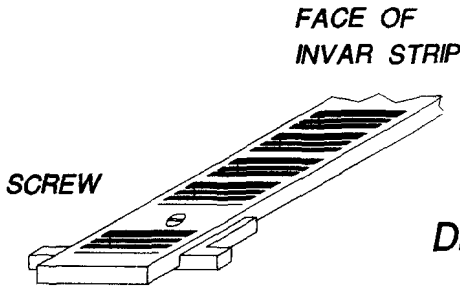


INDEX MUST BE ATTACHED WITH THE BOTTOM EDGE ALIGNED AND PARALLEL WITH THE REFERENCE LINE ON THE INVAR STRIP. IT WILL NOT WORK CORRECTLY IF TILTED SINCE THE TABS WOULD BE HIGHER AND LOWER THAN THE REFERENCE LINE.



USE A SCREW THE FITS THE SIZE OF THE EXISTING HOLE.

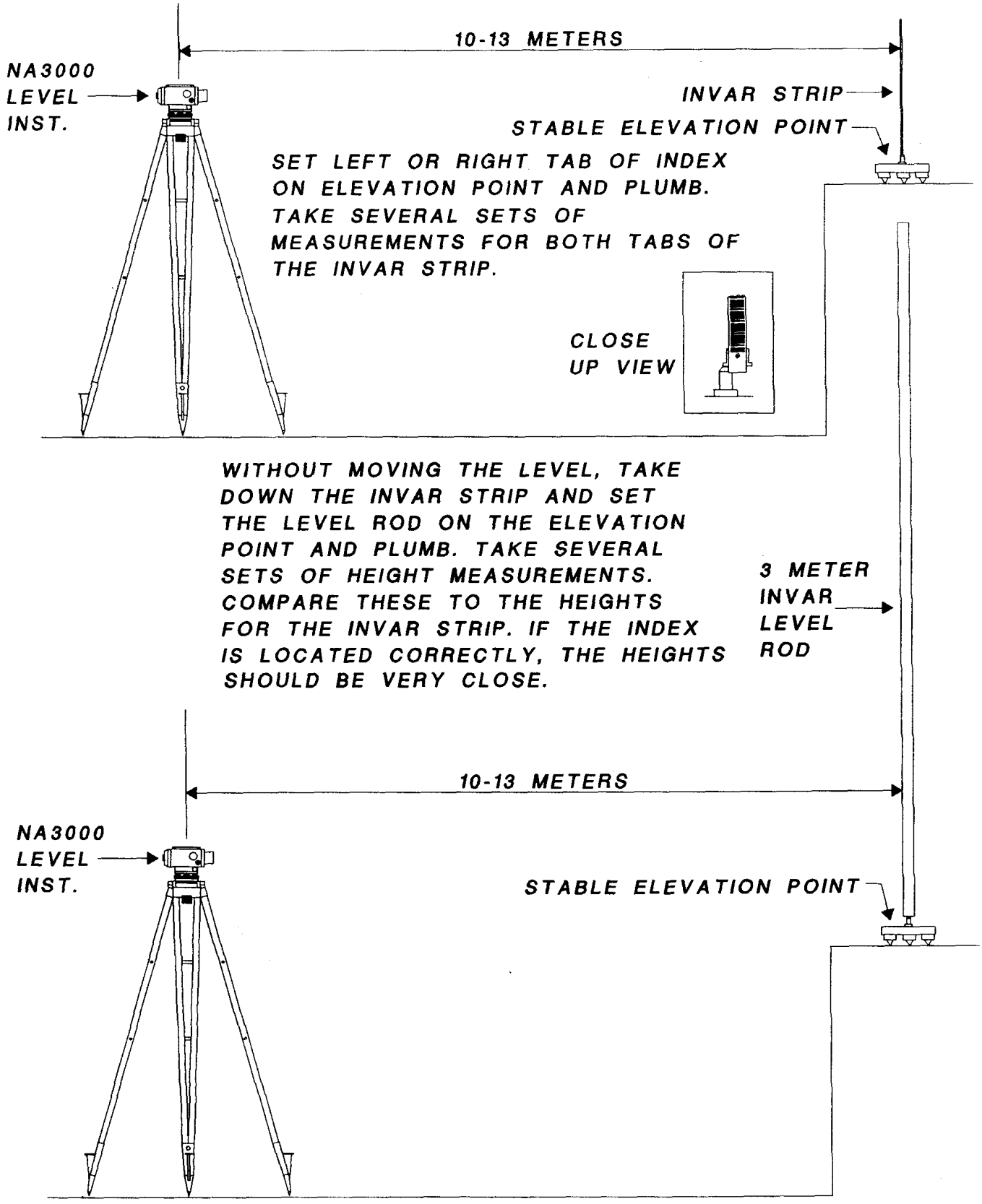




DRAWN BY ORLAND W. MURRAY, NGS, I&M BR. 1/15/98

DRAWING #1

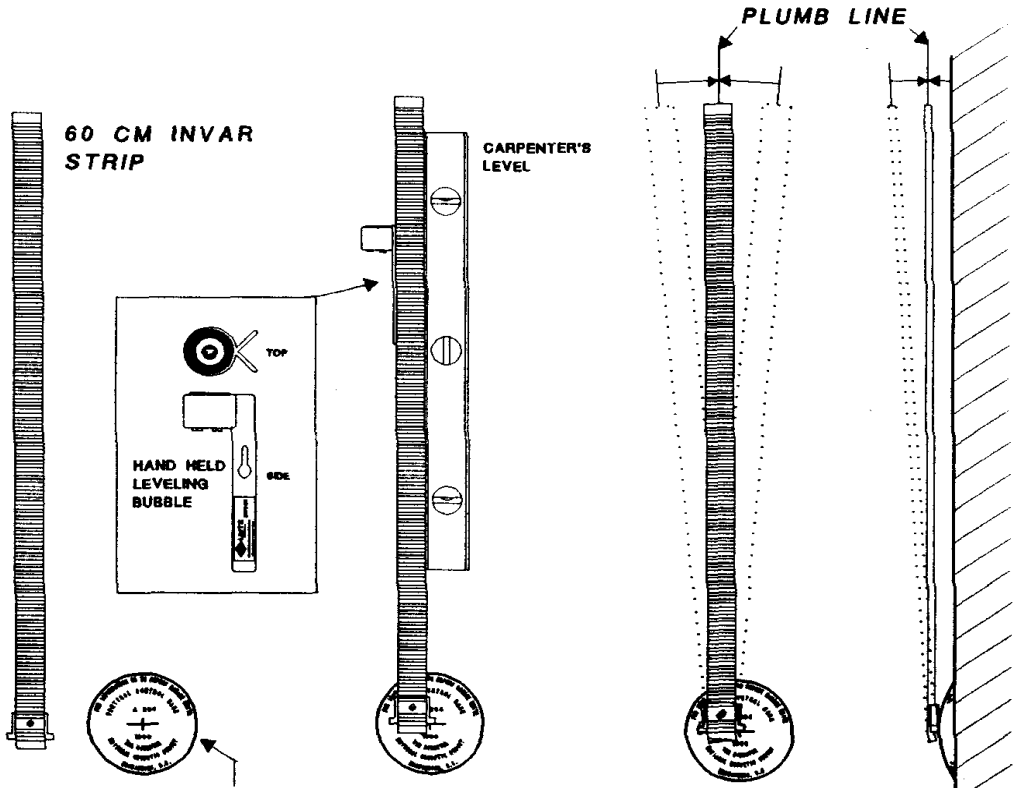
CHECKING LOCATION OF INDEX ON INVAR STRIP



DRAWN BY ORLAND W. MURRAY, NGS I&M BR., 1/20/98

DRAWING #2

USING LEICA'S 60 CM INVAR LEVELING STRIP TO LEVEL TO A VERTICALLY SET BENCH MARK



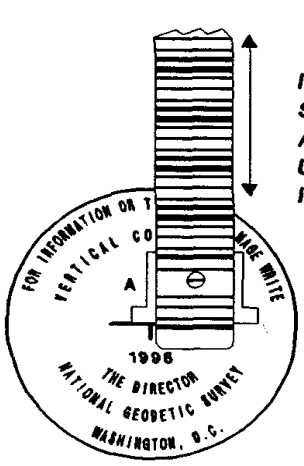
VERTICAL CONTROL MARK OR BENCH MARK SET VERTICALLY IN A WALL OR FOUNDATION

HOLD INVAR STRIP ON MARK WITH INDEX NEAR HORIZONTAL LINE ON DISK

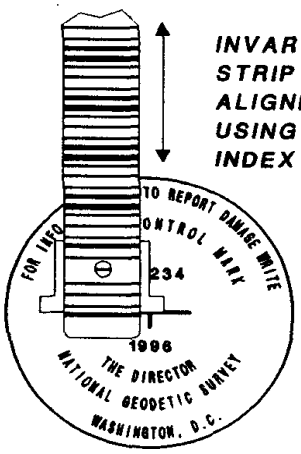
FRONT VIEW

SIDE VIEW

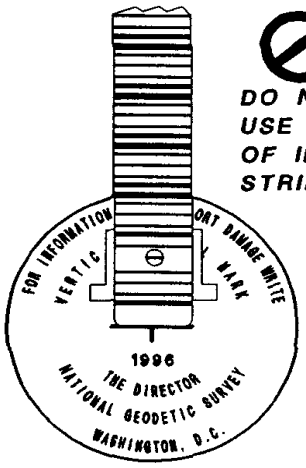
PLUMB INVAR STRIP BOTH SIDE TO SIDE AND FRONT TO BACK



INVAR STRIP ALIGNED USING LEFT INDEX TAB



INVAR STRIP ALIGNED USING RIGHT INDEX TAB

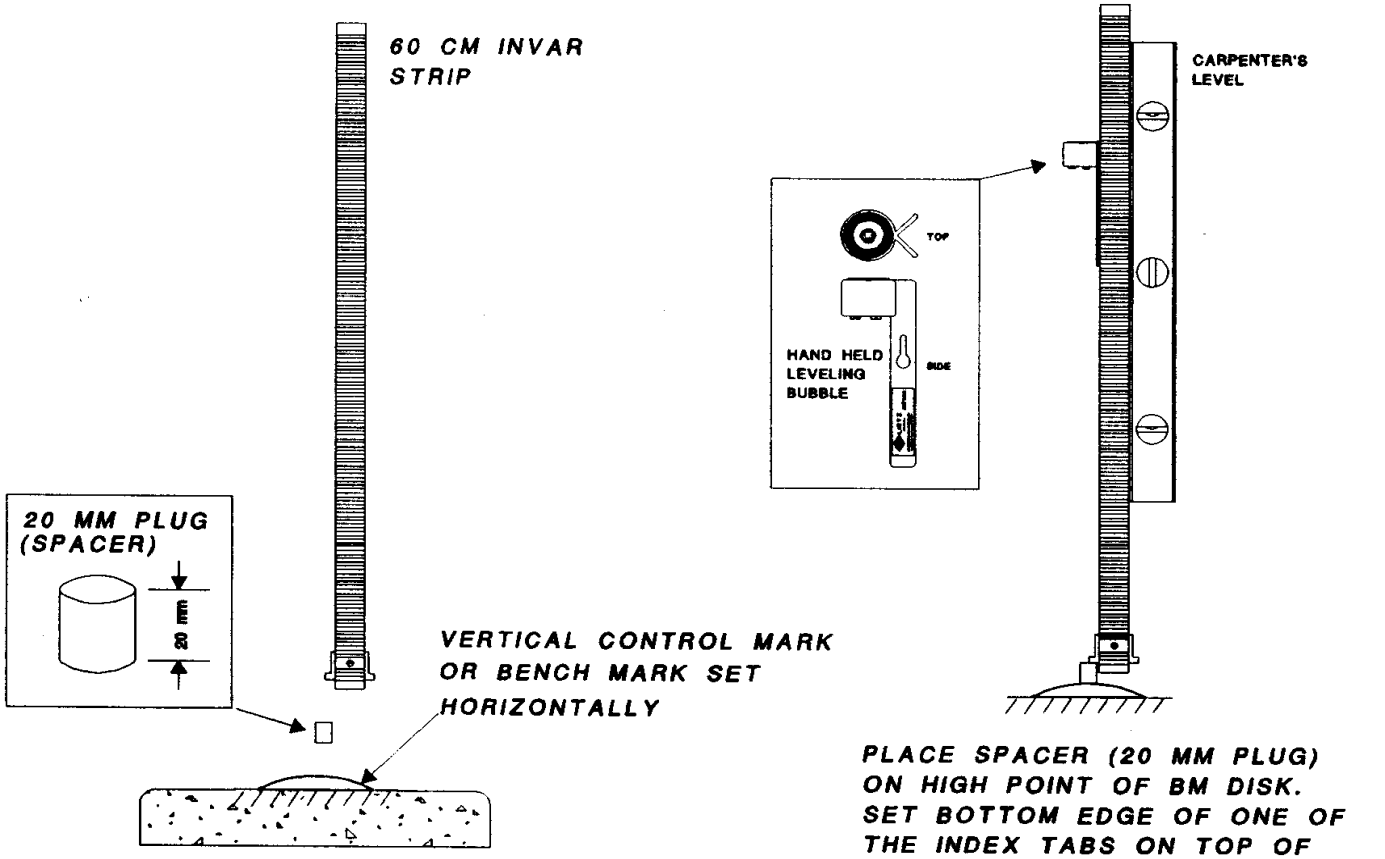


DO NOT USE BOTTOM OF INVAR STRIP

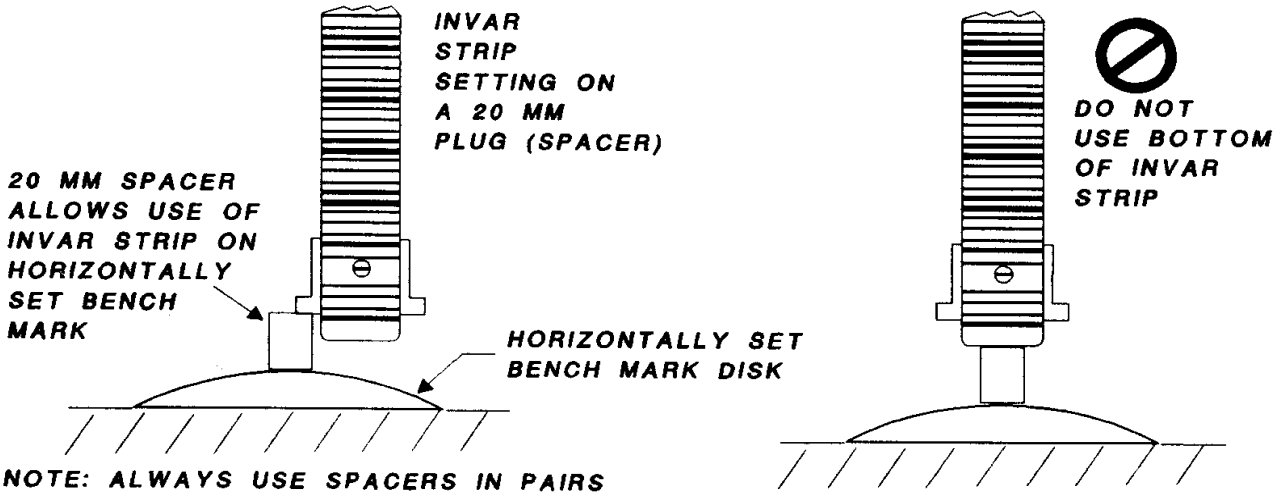
WHILE KEEPING THE INVAR STRIP PLUMB, ADJUST IT UP AND DOWN UNTIL THE BOTTOM EDGE OF THE INDEX REFERENCE TAB IS ALIGNED WITH INTERSECTION OF THE HORIZONTAL AND VERTICAL LINES ON THE VERTICAL CONTROL MARK. USE TWO PEOPLE TO PERFORM THIS PROCEDURE. ONE CAN HOLD AND PLUMB THE INVAR STRIP, WITH THE OTHER ADJUSTS THE INDEX TO THE BENCH MARK. DO NOT USE THE BOTTOM OF THE INVAR STRIP AS THE REFERENCE POINT. USE ONLY THE BOTTOM EDGE OF EITHER OF THE TABS ON THE INVAR STRIP INDEX. (DRAWN BY ORLAND W. MURRAY, NGS)

DRAWING #3

USING LEICA'S 60 CM INVAR LEVELING STRIP TO LEVEL TO A HORIZONTALLY SET BENCH MARK



PLACE SPACER (20 MM PLUG) ON HIGH POINT OF BM DISK. SET BOTTOM EDGE OF ONE OF THE INDEX TABS ON TOP OF SPACER AND PLUMB INVAR STRIP USING HANDHELD BUBBLE OR CARPENTERS LEVEL.



NOTE: ALWAYS USE SPACERS IN PAIRS ONE AS SHOWN ABOVE AND ONE ON THE BACKSIGHT ROD. IF YOU ONLY HAVE ONE SPACER, PUT IT ON THE BACKSIGHT AND READ IT. THEN PUT IT ON THE FORESIGHT AND READ IT.

DRAWN BY ORLAND W. MURRAY, NGS I&M BR.

DRAWING #4

2. Invar scale with bar code GWCL60

2.1. Technical data

Dimensions (L×B×H)	600mm × 25mm × 1.5mm (23.6inch × 0.98inch × 0.06inch)
Division length (region)	0.0cm-59.6cm (0.0-23.5inch)
Weight	0.175kg (0.39lb)
Material	Invar
Divisions	Bar code
Line length	25mm (0.98inch)
Width of a single element	2.025mm
Manufacturing accuracy	According to DIN Norm 18717
Expansion coefficient for the Invar band	< 1ppm/°C
Usable distance	1.8m-20m (5.9ft-65ft). 20m = recommended maximum distance; as when D increases the usable portion of staff decreases.
Usable length	Distance dependent
Reduction	ca. 1% of the distance
At max. usable distance 20m	40cm (15.7inch)
Temperature range	
Working	-20°C to +50°C
Storage	-40°C to +70°C

2.2. Application

Application and accuracy:

Compare with the note found in section 1.2.

2.3. Handling

As with industrial bar coded staffs, the usable length of the staff is dependent on the targeting distance. See also the corresponding note from section 1.3 (reduction of usable length).

The scale has two 3mm diameter holes: one each at top and bottom. You can therefore fix the scale to another object. Make sure that the scale is vertical when installing in this way.

Which end is up (down) on the scale? On the reverse side of the scale, opposite the *MADE IN GERMANY* sign, is a level mark. This mark represents the start of the divisions (0.0cm). See figures 2 to 4.

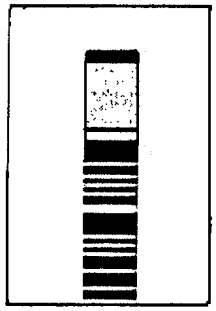


Figure 2: Top end

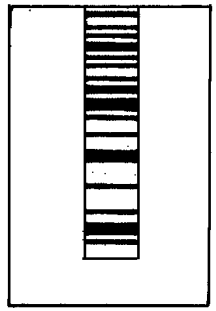


Figure 3: Bottom end

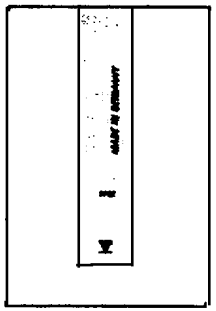


Figure 4: Reverse side, bottom end with zero-mark.