

# Tapes and Rods in the Metric System

With the conversion to the Metric System, Surveyors and Engineers have to change their tools to metric tapes and rods. This change brings many uncertainties when it comes to choosing the proper tapes and rods.

## METRIC TAPES

Ontario Ministries, Municipalities and private companies have experimented with various devices and graduations in the last few months, or even years, to find an answer to their individual requirements and needs as far as the metric tape is concerned.

The main feature of any tool in the Metric System is the clear and unmistakable graduation into 5 units. On a tape, it should be a distinct mark every 5th centimetre, or millimetre. This graduation, in five equally wide spaces, is preferred because the human eye can easily visualize the five graduations in one glance. Any different graduation, other than 5 units, will confuse the eye and give cause for errors in reading the tape. It, also, slows down the work considerably.

The changeover from the Imperial System to the S.I. System should be made totally, and no tape should have dual markings. Such tapes give rise to unnecessary mistakes, especially when the instrument man is reading the tape on a long distance and the tape is twisted, or the wind turns the tape to the wrong markings.

Add-tapes, as they were used in the Imperial System, are not common and not desirable in the Metric System. The tape in the Imperial System was graduated in feet, and only the first and last foot was graduated into hundredths of a foot. Therefore, an addition of one foot on the zero-end of the tape, in reverse numbers, made it easy to read the proper distance. This type of arrangement in the Metric System is neither feasible nor practical, since each metric tape should be fully graduated into spaces not exceeding one centimetre. If the party chief is not sure that his rear chainman can estimate or read the tape properly, let the rear chainman hold the zero-end, and the head chainman can read the chain in the centimetre graduation to the nearest millimetre without much trouble. No tape should be pulled more than the tension suggested by the manufacturer.

The length of the tapes or chains should be considered in the light of certain requirements for efficient use. A 50-metre tape is not feasible for work

where we seldom measure distances more than 20 to 30 metres. A long tape is subject to more abrasion when using the reel. This means, the markings in the first 10 metres could be more easily damaged than on a shorter tape. The effect of fish-tailing of the end of the tape causes metal fatigue and leads to breaking of the tape in the first metre, or so. A light and smooth end-piece is preferable to a heavy, easy-catching type.

Recommended lengths for tapes are 50m, 30m, or even 25m. For layout of engineering stations at 25m intervals, it might be advisable to use a 25m tape instead of 30m tape, for easier location of the individual stations. Occasionally, a 100m tape might be required. This type of tape should be graduated in centimetres only and each graduation should be high, or deep-etched into the steel for longer wear.

The Northern Drag Tape, or Babbit Tape is a useless tool in any system, Imperial or Metric. The soldered metal pieces at each interval are inaccurate and each section of tape has a different weight. Such tapes are unsuitable for any accurate surveying work since they do not lead to proper sag corrections.

The modern fibreglass tapes are well manufactured and can be applied to certain types of jobs. Jobs involved with Engineering surveys, surveys of small house lay-outs, surveys which are relevant to hydro power lines, or pipelines which created static electricity (see Alaska Pipeline explosions) and survey measurements across main traffic arteries which all call for the use of non-metallic tapes. But, we must also give careful consideration to the accuracy which can be expected from this type of tape. A good fibreglass tape is specified to be accurate to within 2mm for a length of ten metres, or 0.02%, if the pull is in accordance with the manufacturer's specification. Any non-metallic tape should be graduated in centimetres. Any graduation smaller than the above mentioned is giving rise to an illusion of accuracy, which no reputable manufacturer will provide, in order "not" to put his reputation at stake. The recommended graduation will enable any intelligent chainman to estimate the distance to the nearest millimetre, after a relatively short time of practice. Requirements for millimetre graduation on non-metallic tapes are sometimes requested in specifications, but are very hard to manufacture and give cause to more inaccuracy than the above suggested estimation by the surveyor's assistant. In other words, do not expect higher accuracy by smaller graduations

which is not consistent with the material used.

## METRIC RODS

The levelling rods have also specific points like the above-described tapes, which should be considered. Any good metric rod should have even and odd-numbered metres shown in a different colour. For instance; red on white or black on white, orange on white or any other distinct combination.

As with the tapes, the five unit concept should be adhered to. The best in this line is the rod marked with E's where each bar of the "E" is one centimetre in width. Any smaller graduation is confusing and does not add to the accuracy in the reading to the nearest mm. Any instrument-man can estimate to the nearest millimetre after a very short time of practice. Each decimetre on the rod should be clearly marked, as to the metre and decimetre, which is in the visual field of the instrument. Do not buy any rod which causes you to count the spaces between two marked points. It increases the occurrence of errors and the time required to take a reading.

The markings on the rod should be well protected against wear-and-tear in the trunk of the car, or on the truck. This can be accomplished by having a folding rod with the marked faces all on the inside of the folded rod. The refacing of any rod, marked in Imperial measurements with plastic metric graduated facing, is not recommended. There is no guaranty that the facing will be properly glued on. Each individual rod may have an error in its graduation. This error can fluctuate when there are several sections individually glued on. This can cause gross errors if the rod is read in different sections, or different rods are used alternately on the job.

One specific type of rod should be mentioned here; the one-piece rod in 4 to 5 metre lengths for precise levelling to first order accuracy. The rod should also be graduated in centimetres. The one-piece rod is essential for this type of accuracy, since it has no constant or inconsistent accumulating errors as have the commonly used sliding rods. The sliding rods have a great drawback, as it is entirely up to the rodman how long the rod is extended. This could result in considerable errors, when you want to run a level loop to a relatively high standard of accuracy (2nd or 3rd order). In the Metric System, the folding rod is more widely used than any other rod.

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