

ELEKTRA MAGNETIC SCALE

(OPEN EXTRUSION- upto 1 meter)

Reader Head EMR - B

For metal cutting machine tools

TECHNICAL AND INSTALLATION MANUAL


electronica

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3) Magnetic Stand - At any time during maintenance avoid using magnetic stand near the magnetic scale at any time. If the permanent magnets of the magnetic stand touches the magnetic tape inside the extrusion accidentally it will permanently damage this magnetic scale.

10. NOTES ON SAFETY

- 1) The magnetic tape may only be transported in its original packing. The same is to be used for storing.
- 2) Remove the magnetic scale from its packing at the site of installation and immediately only prior to installation.
- 3) **Do not touch any permanent magnet to the magnetic scale. Irreversible damage will be caused to the scale by doing such a thing.**
- 4) **Ensure that magnetic scale does not come in contact with kerosene or petrol.**

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1. INTRODUCTION

The Elektra linear magnetic scale (open extrusion) measures the displacement precisely and accurately. To ensure the specified accuracies, installation of magnetic scale (open extrusion) must be done correctly as described in this manual.

This manual contains instructions for installing Elektra magnetic scales (open extrusion) which are normally used in conjunction with Elektra Digital Readout and control systems. Basic steps should be understood and followed systematically and care should be taken to perform all procedures carefully.

Read this manual carefully and thoroughly before use of the product

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Definition of Accuracy

The extreme values of the error with reference to their mean value should lie within the accuracy class mentioned for a position within any 1 meter section of the measuring length. The reference temperature considered for the Accuracy class is 20°C.
(referred with Heidenhain and Numerik Jena manuals)

9. MAINTENANCE

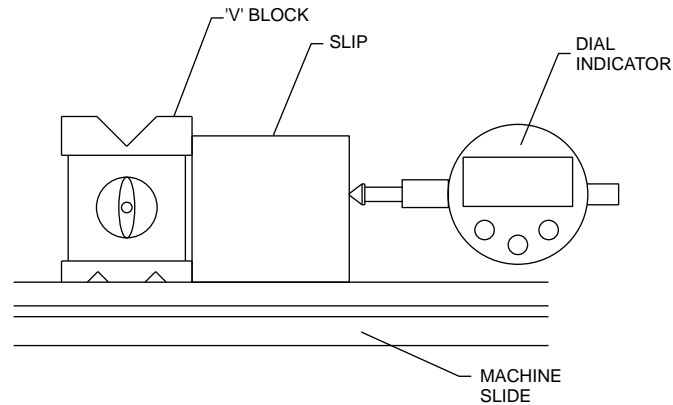
As the basic magnetic scales have very high reliability due to their nature, there is almost no maintenance required if used properly.

As a preventive action, as a part of TPM (Total Plant maintenance), we suggest you to follow two things to be done as a regular check once in 3 months / 6 months depend upon the use of machine.

- 1) Check that alignment of scale is not disturbed due to any unknown external reason.
- 2) Make sure that wiping action is smooth & reliable over the entire travel of the scale.

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touch the other end of the face to the dial adjusting it to zero. Now the counter should show 100mm. If the display shows reading outside the allowed distance, then calibrate the DRO unit by calibration process as explained in the DRO operational manual. So that counter has to show 100 mm. Reinsure the accuracy. Now you are ready to use the system.



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2. WHAT IS A MAGNETIC SCALE

Glass scales have been very popular for measuring length, dimensions of a part, distance traveled etc. in machine tool, profile projector, Metrology equipments and such areas for many years. Glass scales give reliable results in clean area and come with both high resolution as well as low resolution, high accuracy as well as low accuracy and lengths normally upto 2 or 3 meters.

Over the period a large number of machines / applications have come up where glass scales cannot suit the requirements such as:

The environment is dirty

There is presence of large cutting oil

Vibration

The scale needs to be fitted on bent surface (Direct Angular measurement)

Accuracy is low, but cost also needs to be much low

To fulfill such demands a new Technology has emerged over the last decade magnetic scales.

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These scales are based on magnetic principal and can satisfy the above needs. They are becoming more and more popular due to their unique features and cost to benefit ratio.

In this article, we will explain you how a magnetic scale is made, how it works and its applications.

You know magnetism, now do you know a very important thing that magnetism passes through water, through oil, through wood through paper, through dirt, it passes through all these materials that is the property of magnetism. Now what we do in order to magnetism work for us is we take magnetic material powder mostly what is called as Barium Ferrite mix it with a plastic compound and extrude a section looking like Fig. 1.

This magnetized strip looks like this,

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8. REPEATABILITY CHECKING OF THE SYSTEM AFTER INSTALLATION

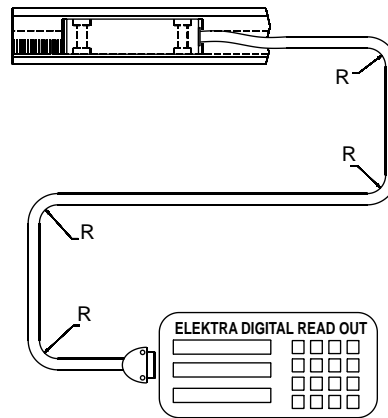
Set a Dial Indicator with the help of magnetic stand on the machine and reset the dial and counter to ZERO. Move machine table over full stroke move back until the dial reads ZERO. The counter should also show ZERO. Then this indicates that Repeat position of the DRO system installed on the machine is correct. This is called REPEATABILITY OF THE DRO SYSTEM.

ACCURACY CHECKING OF THE SYSTEM AFTER INSTALLATION

After checking repeatability, positional accuracy is to be checked with the help of standard slip gauge. For example, checking positional accuracy for long scale of machine Put 'V' block on the table and align one face of 'V' block with the help of dial gauge to zero by moving cross slide of the table. Then touch the dial to align 'V' block face and load the dial to 0.2mm make the dial and counter zero. Then move the table in such a way that a standard slip (e.g. a 100mm slip) can be inserted between 'V' block and dial. Touch one face of the slip to the aligned face of 'V' block and

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**READER HEAD WITH
OPEN EXTRUSION MAGNETIC SCALE**



WHERE, R IS NOT LESS THAN 60mm.

FIG. 14 INSTALLATION LAYOUT

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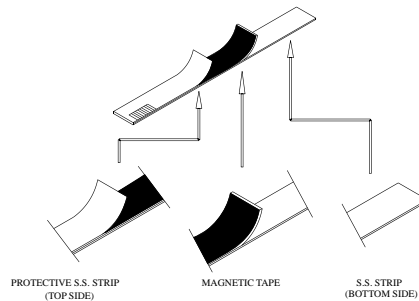


Fig. 1

This we cannot use as it is, because it will break or if you stretch it will cut, so immediately we glue it on stainless steel strip. So we have a magnetic strip which is strong because it is glued on to a thin stainless steel strip.

Now this is a magnetic strip it is yet not the scale. It is a magnetic strip which is useful to us. Now we need to magnetise it. So one of the most interesting and important technology in magnetic scale is magnetizing the magnetic strip. It is magnetized with a very special machine.

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This steel backed up magnetic strip is magnetised with the help of a magnetizer for alternate poles N-S-N-S-N-S of desired width (say 2mm, 5mm,). See Fig. 2.

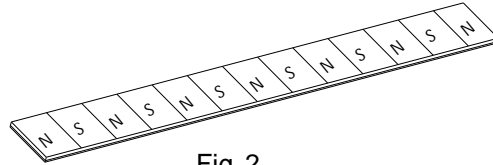


Fig. 2

The Magnetic sensor is made to move along the length of this strip at right angle to the poles as shown in Fig 3.

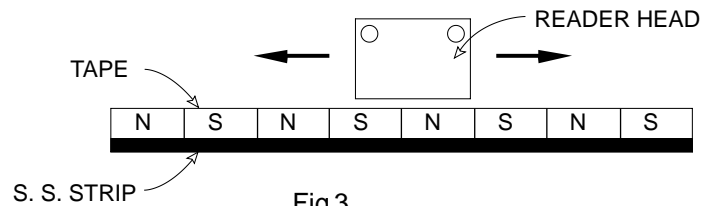


Fig 3.

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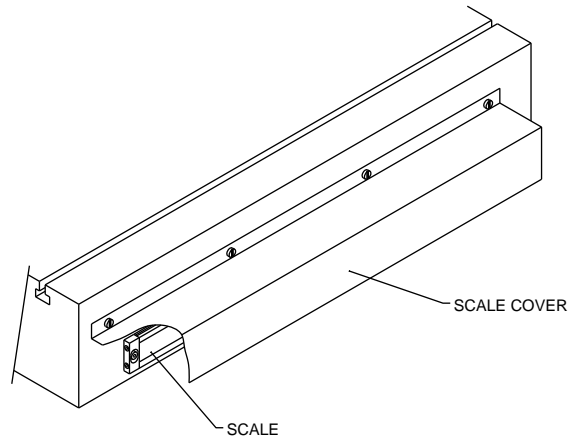


FIG. 13 INSTALLING SCALE COVER

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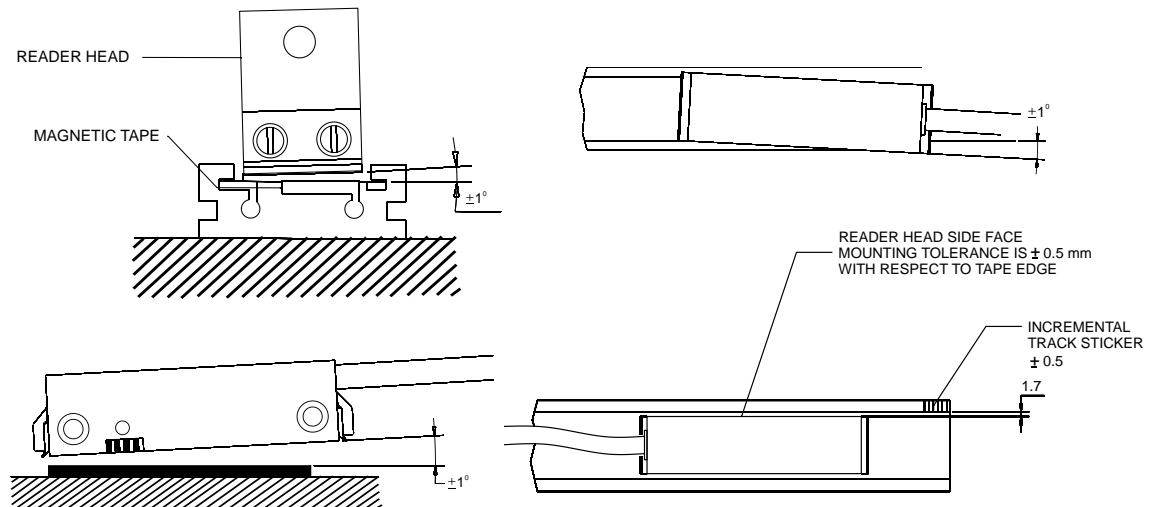


FIG. 12 READER HEAD MOUNTING TOLERANCES

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The sensor detects the changing magnetic field and gives voltage signal output.

This voltage signal is further interpolated and the required pulse train output is obtained along with direction signal. With the help of this pulse train O/P distance measurement can be obtained.

This is how a magnetic linear encoder works. Air gap between the sensor and the magnetic strip is decided depending upon the magnetic field strength and sensitivity of the sensor. It is normally of the order of 0.5 to 2 mm depending upon pole pitch, accuracy etc.

3. TECHNICAL SPECIFICATIONS

- | | | |
|--|---|---|
| 1. Resolutions with four edge detection | : | 5, 10, 20 micron |
| 2. System accuracy / meter | : | ± 10 , ± 20 , ± 50 , micron |
| 3. Repeat accuracy | : | ± 1 count |

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- | | | |
|--|---|---|
| 4. Current consumption | : | Typ. 150mA max. 250mA / |
| 5. Power supply | : | 5V DC $\pm 5\%$ |
| 6. Output signal level | : | A. 5 V TTL.
B. RS 422 5 V high > 2.5 V, I = 20mA
Low < 0.5 V, I = 20 mA
(optional) |
| 7. Operating temperature | : | Max. 50° C |
| 8. Storage temperature | : | - 20° to 70° C |
| 9. Output signals | : | A, \bar{A} , B, \bar{B} , Reference and
Reference (Z) (Z) |
| 10. Maximum measuring speed for scale | : | 10 meter / sec. (32 feet/sec.) |

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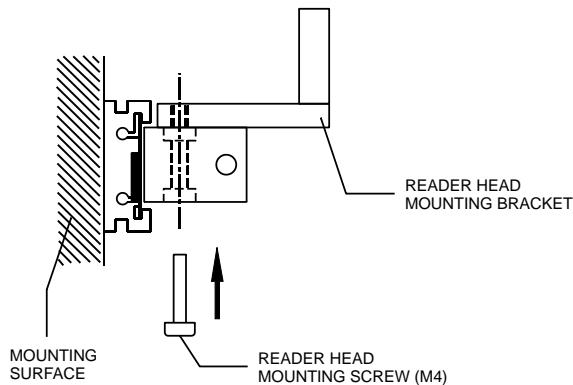


FIG. 10 READER HEAD INSTALLATION

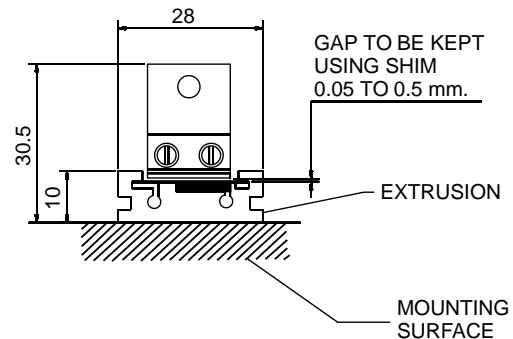


FIG. 11 GENERAL ASSEMBLY

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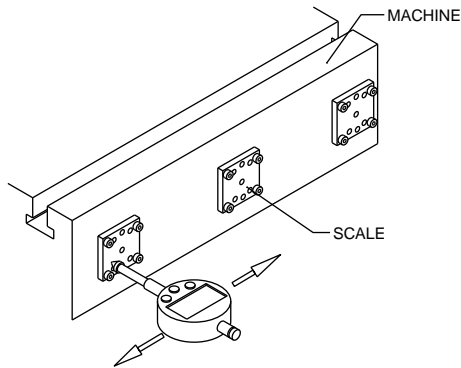


FIG. 8 SCALE MOUNTING METHOD

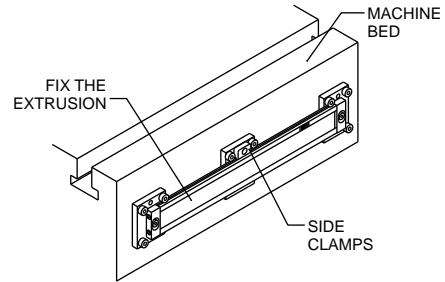


FIG. 9 SCALE MOUNTED ON BLOCKS

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- | | | |
|---|---|--|
| 11. Temperature Co-efficient | : | 10.6 X 10 ⁻⁶ / degree C |
| 12. Gap (Sensor bottom to Scale) | : | 0.5mm ± 0.2 mm |
| 13. Signal cable length
(The signal cable is with metallic conduit) | : | Standard 3 mtr upto 800 mm scale
Standard 5 mtr beyond 800 mm scale

(Total cable length can be 20 mtr using additional extension cables) |
| 14. Signal cable bend radius | : | Min. 60mm. |
| 15. Metallic (Stainless Steel) Wipers | : | Standard |
| 16. Reference (Index) Mark | : | At every 50 mm
(special on request) |

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Material	Reader Head :	Scale :
Height	22mm	10 mm
Width	16mm	28 mm
Length	60mm	-
Material	Alloy Aluminium with Stainless Steel bottom	Aluminium

NOTE:-

- 1 If measuring length of scale is X mm. Then tape in extrusion supplied will be $X + 85\text{mm}$
- 2 Non magnetic portion of the scale at each end of 10mm length is provided at each end of the scale so that magnetic dust pushed by the wiper will fall off.

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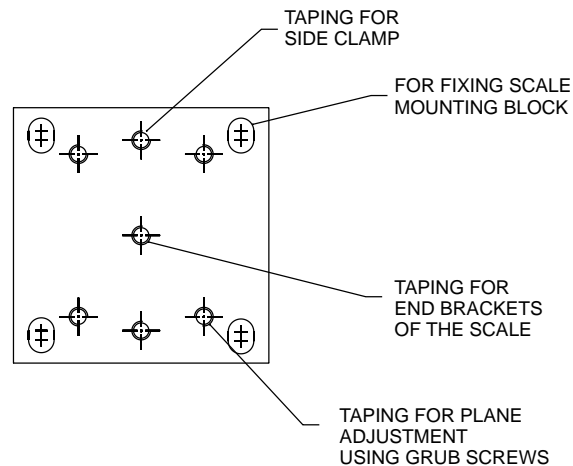
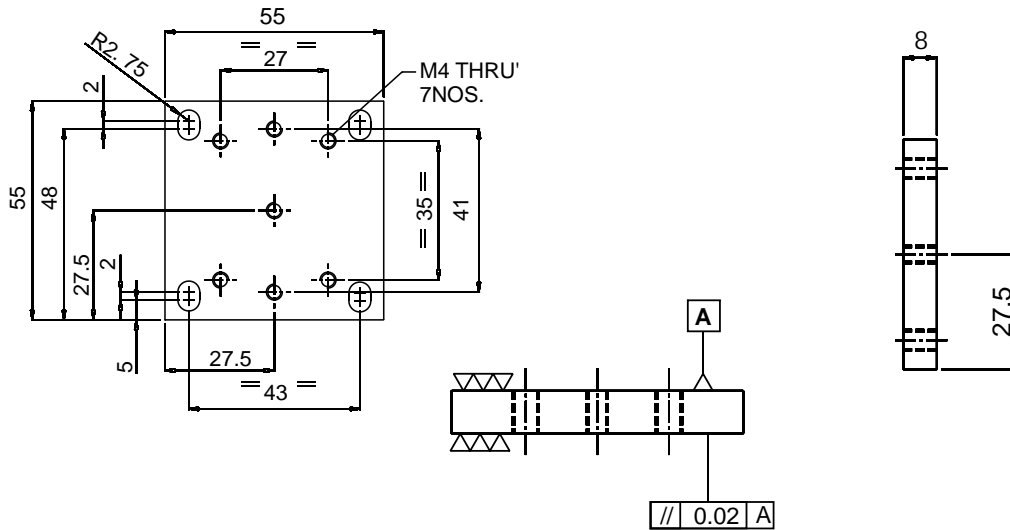


FIG. 7 SCALE MOUNTING BLOCK

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4. PIN CONNECTION DETAILS : (For Reader Head with Steel Conduit) READER HEAD CONNECTOR (9 PIN D TYPE)

A. Without Line Driver.

PIN NO.	SIGNAL	COLOUR CODE
1	Z	GREY
2	--	--
3	VCC (+ 5 VDC)	BLACK
4	AC GROUND	VIOLET
5	GND (0V)	WHITE
6	PHASE A	PINK
7	--	--
8	--	--
9	PHASE B	YELLOW

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B. With Line Driver.

PIN NO.	SIGNAL	COLOUR CODE
1	Z	GREY
2	\bar{Z}	BROWN
3	VCC + 5 V	BLACK
4	AC GROUND	VIOLET
5	GROUND	WHITE
6	PHASE A	PINK
7	PHASE / A	RED
8	PHASE / B	GREEN
9	PHASE B	YELLOW

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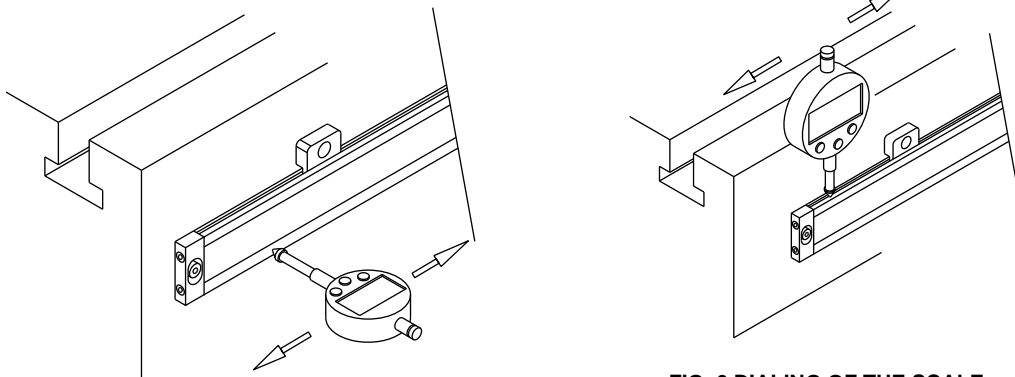


FIG. 6 DIALING OF THE SCALE

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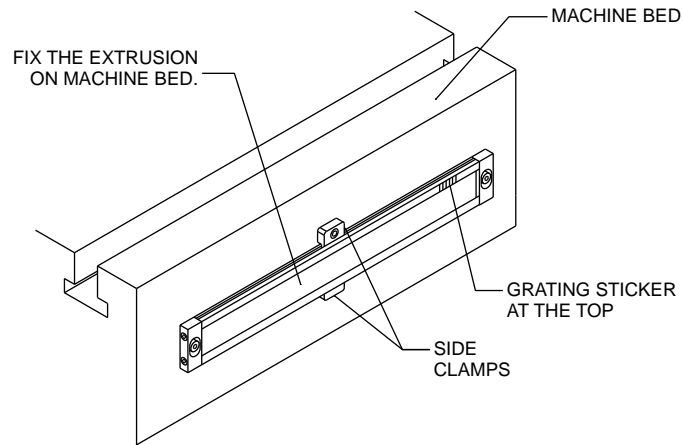
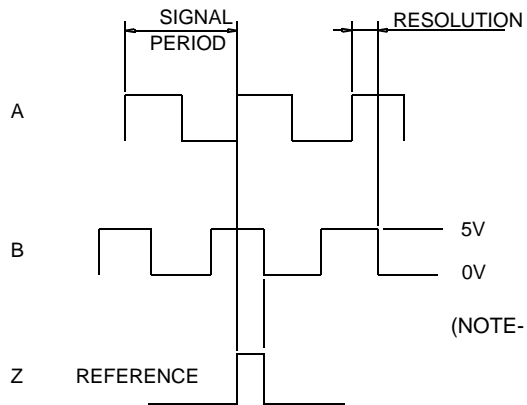


FIG.5 TYPICAL INSTALLATION OF SCALE

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5. OUTPUT WAVE FORMS

INCREMENTAL 2 CHANNELS A AND B (90° PHASE SHIFTED)



(NOTE- SIGNAL PERIOD IS 4 TIMES GRATER THAN RESOLUTION)

(INVERSE SIGNALS \bar{A} , \bar{B} AND \bar{Z} ARE NOT SHOWN)

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6. CONSTRUCTION

All our products are based on two basic elements.

1. Magnetic Scale
2. Magnetic Reader Head.

Magnetic Scale : This consists of the Magnetic Tape (called also as magnetic band) which is the magnetized Extruded plastic material section glued on stainless steel strip. For more information, refer chapter 2.

For ease of installation on machine tools, magnetic tape is put in Aluminium extrusion Ref. Fig 1. The Magnetic Tape is glued firmly with a double sided tape in the groove and a thin (0.15mm thick) stainless steel strip is inserted over the Magnetic Tape in the Aluminium section through the grooves provided for it. This S.S. strip protects the Magnetic Tape from any accidental damage as well as keeps any dirt away from it. Two end brackets, one at each end locks the S.S tape at both ends. Fig 2.

Holes provided in these end brackets are for mounting the scale on machine tool.

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While mounting the reader head make sure that dimple/sticker on the reader head is facing lines sticker on the extrusion.

INSTALLING THE COVER :

Provide a proper cover to protect scale & sensor for the entire length of the scale to ensure the reliability and performance of the system. Fig. 13. The cover gives protection against oil, coolant, & chips.

CABLE ROUTING

Cable must be kept out of the way of moving parts of the machine. Ensure that it will never get pulled or pushed during machine operation. Cable should not be bend below radius 60mm during routing. Fig 14. Cable should not be routed near any inductive load to avoid electrical noise interference.

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- 7) Use the side clamps at every 500mm. Refer Fig 6 or 9.
- 8) After aligning these both brackets mount the scale on the mounting brackets with the help of M4 Allen bolts at end bracket of the scale.

MOUNTING OF SLIDER (SENSOR) UNIT :

Mounting bracket (Fig 10) for slider location should be decided that slider should move over the scale for full traverse of the machine slide and equal gap should be maintained between slider bottom and stainless steel cover through out its travel. (Fig 11) Manual feed is desirable. The Slider must be fitted with the help of M4 allen screws firmly. Gap between scale and slider should be maintained with the help of shim. To achieve this gap put the plastic shim between the reader head bottom and stainless steel strip of the scale. Press down the reader head firmly till bottom of the reader head touches the shim, hold the reader head or the reader head bracket in that position and tighten the M4 slider mounting allen screws of the mounting bracket. After gap set remove the plastic shim and reconfirm the gap.

Look at Fig 12 for mounting tolerances for mounting the reader head.

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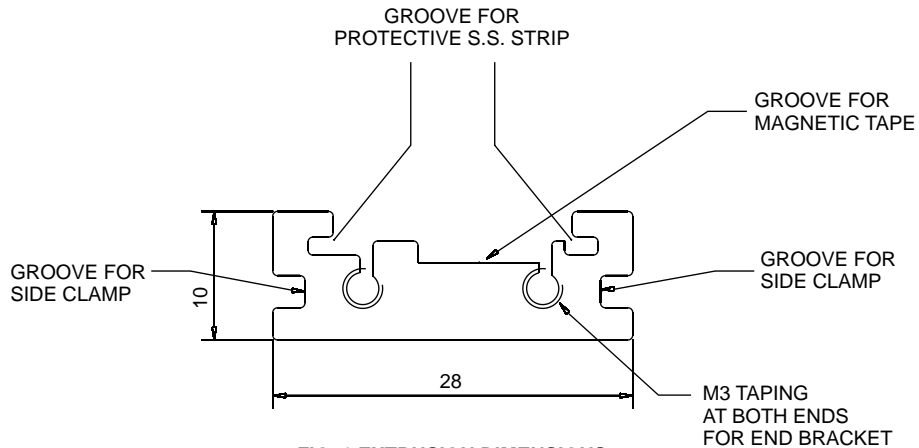
Reader Head : This is the most important part of the measuring system. It consists of an Aluminium box in which is housed the electronics including the magnetic sensor. At the bottom of the sensor is a stainless steel plate to prevent any damage to the sensor due to foreign body. From one side of the box a cable with conduit comes out with cable carrying all signal and supply wires.

For making the Reader Head work in oil, water . . . and also to make it shock and vibration proof, it is fully potted.

During operation Magnetic dust can get collected on the surface of the magnetic scale. It is always better to remove it or otherwise it may damage the Reader Head after long use. In order to avoid it this dust should be scraped away. For this purpose wipers made from thin S.S. sheet are mounted at both ends of the Reader Head. Thus at each travel this Magnetic dust is pushed to the end of the scale, beyond the measuring length, keeping the scale clean always. Fig 3.

For dimensional details of the Reader Head refer to Fig 4.

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- 2) If the scale mounting surface of the machine bed is even within 0.1mm per mtr, then mount the scale directly on the machine bed by using M 4 Allen screws through the hole in the end brackets on the machine bed in desired position. The scale should be mounted in such a way that the top face and the front face of the scale should not exceed 0.1mm/mtr. Fig 5 & 6.
- 3) Check the parallelism to full length scale with the dial indicator firmly mounted on M/c and by moving the table to and fro manually (Manual feeding is preferred to power feeding for alignment of scale.)
- 4) If the scale mounting surface is uneven (more than 0.1mm per mtr) then scale mounting blocks (one for each end need to be manufactured before the installation for alignment of the scale.)
- 5) In such case, manufacture the scale mounting blocks as per Fig 7. Mount these blocks on the machine bed so they are at the two ends of the desired position of the scale. Check alignment of these blocks Fig 8. Mount the scale on these blocks and repeat the dialing procedure as shown in Fig 6.
- 6) For dialing do not use motorized feed as mentioned in above point no.3.

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7. INSTALLATION

1. INSTALLATION PROCEDURE FOR MAGNETIC SCALE (OPEN EXTRUSION) :-

INSTALLATION CONDITIONS

- The place where the scale is to be installed should be thoroughly cleaned from oil, dust, coolant, burr etc.
- Appropriate reader head mounting bracket to be designed to fix the reader head such that it can freely move on the magnetic scale.
- Scale should be mounted in such a way that the grating sticker on the extrusion should be on top side.

INSTALLATION PROCEDURE

MOUNTING OF OPEN EXTRUSION MAGNETIC SCALE UNIT

- First decide the position of location of scale mounting as explained earlier.

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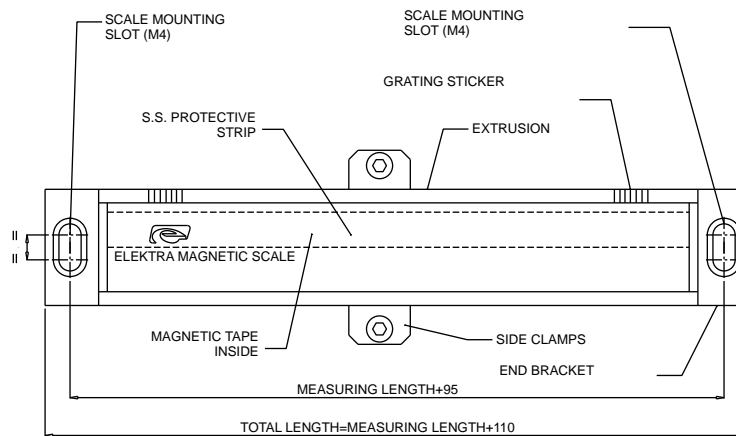


FIG. 2 DRAWING FOR EXTRUSION WITH TAPE INSIDE

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