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## ***BELTCON 3***

Visual Scanning of Steel Reinforced Conveyor Belting

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VISUAL SCANNING OF STEEL REINFORCED CONVEYOR BELTING

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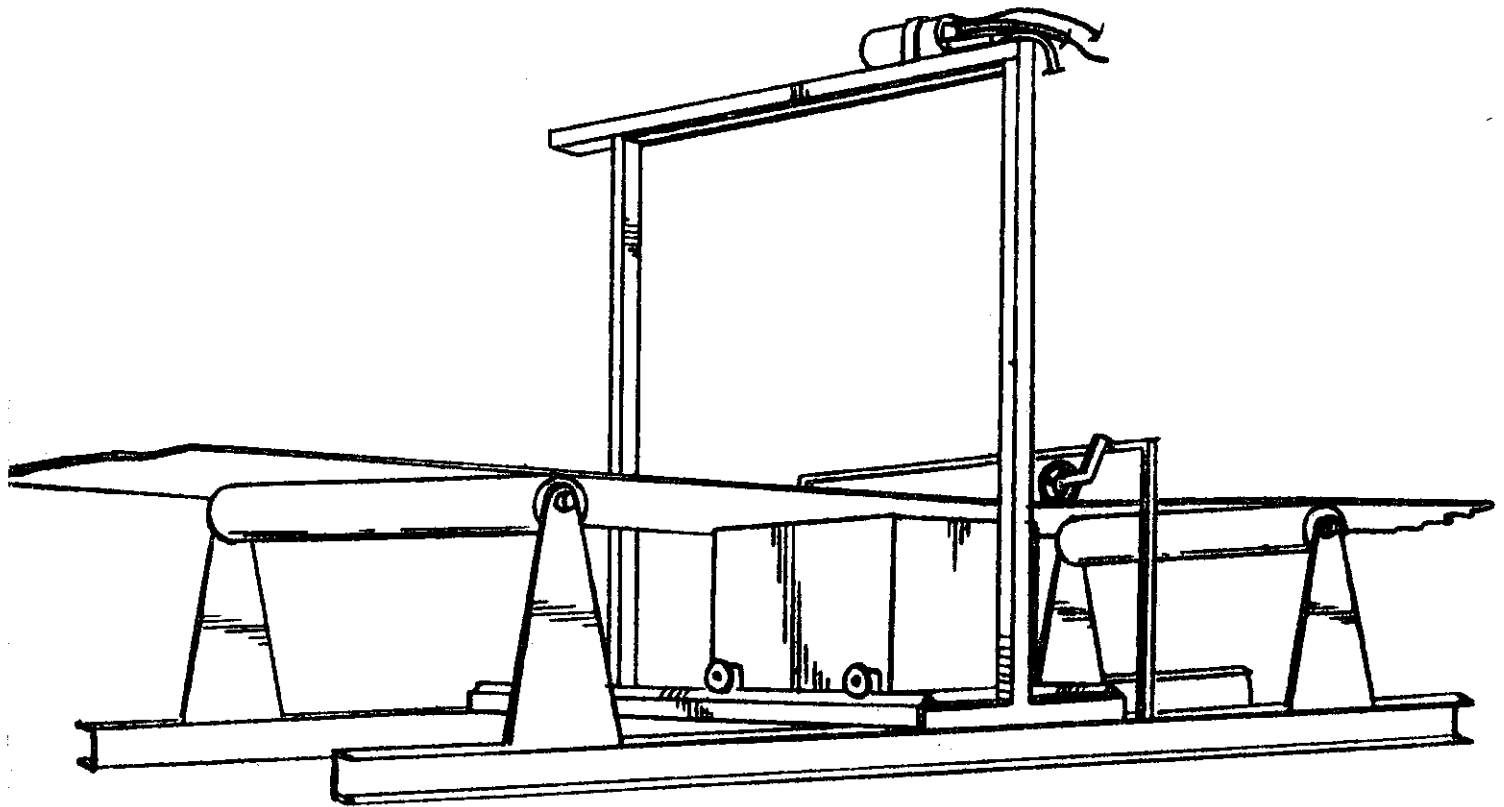
## 1.0 INTRODUCTION

On site scanning of the carcass of steel cord reinforced conveyor belting has been practiced for many years, however, its potential as a tool in the hand of the maintenance engineer has not previously been fully appreciated and utilised.

The benefits that can be gained from this type of monitoring are numerous and can assist the conveyor belt user to get the kind of life out of the belt that the manufacturer designed it for.

The Belt Manufacturer can also, by using the unit in a Quality Control Application, prevent any sub standard belts from finding their way into the field.

In this paper it has been endeavoured to highlight what are possibly the most important types of conditions or defects that the monitor can give warning of to prevent unscheduled downtime and waste of materials and manpower.



## 2.0 THE X-RAY MONITOR

### 2.1 SCOPE

The unit monitors or inspects the carcass of conveyor belts where the material used is impervious to the penetrating rays (e g steel cord reinforcing).

### 2.2 APPLICATION

Inspections can be carried out in situ or in a manufacturing environment. A continuous visual image of the carcass is displayed on a monitoring screen, indicating the position and condition of the steel cords and splices.

Rusted and broken cables are clearly visible as well as splicing and manufacturing deviations.

### 2.3 INSTALLATION

The current installation and set up time is approximately 45 minutes and the monitoring period depends on the length, speed and width of the belt being examined based on the following formula.

$$St = \left( \frac{L \times BW}{V} \right) \frac{R}{SW} \times 60$$

St = Scanning time in minutes  
L = Conveyor belt overall length (M)  
V = Belt Speed (m/sec)  
BW = Belt width (mm)  
SW = Scanning width (mm)  
R = Revolutions per scan •

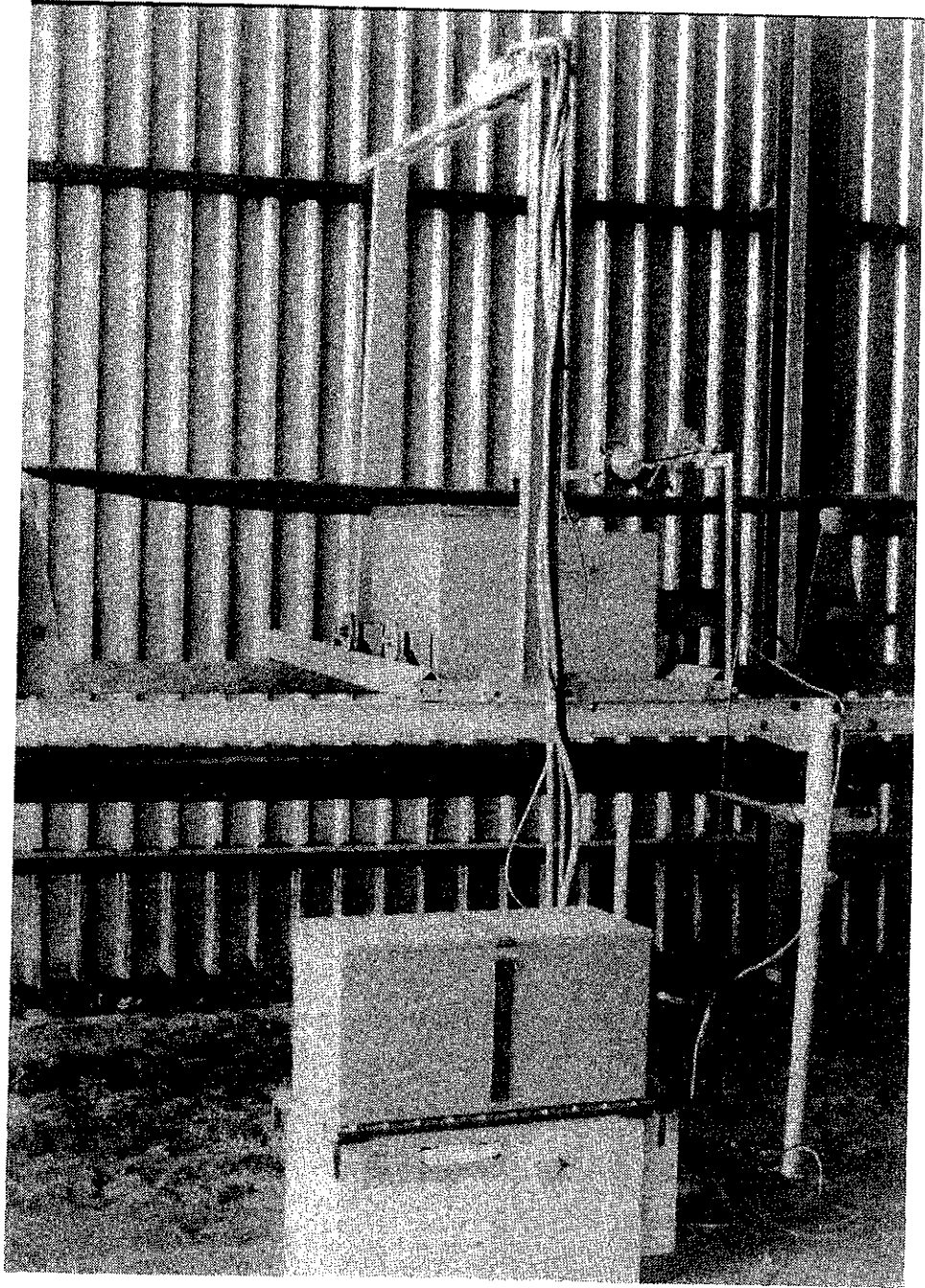
The norm is two revolutions per scan.

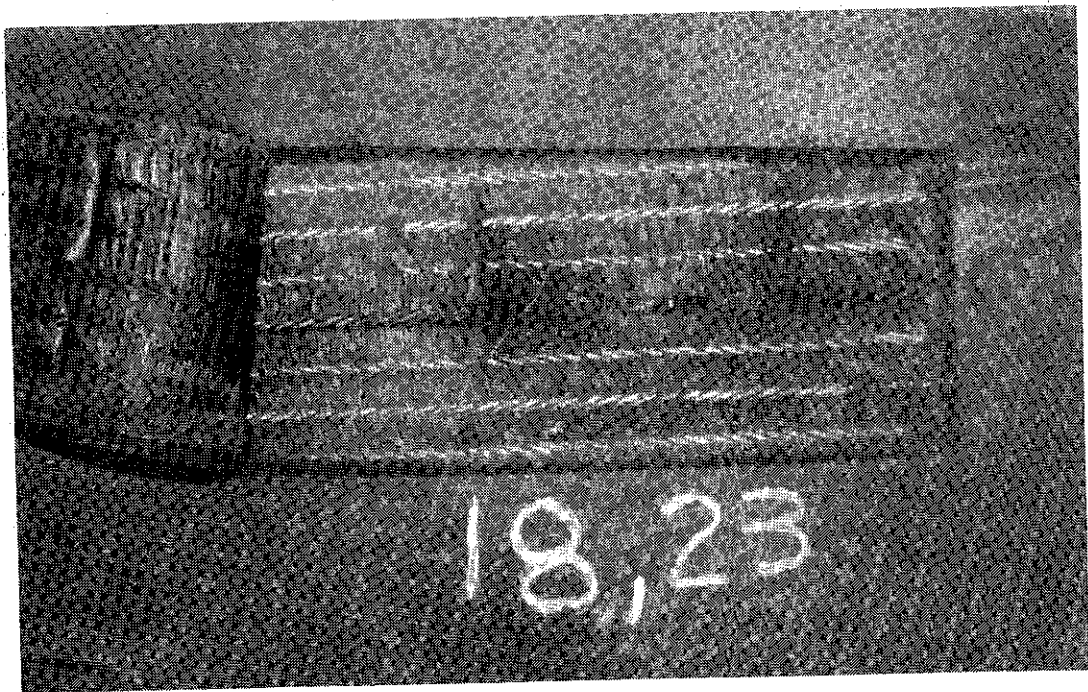
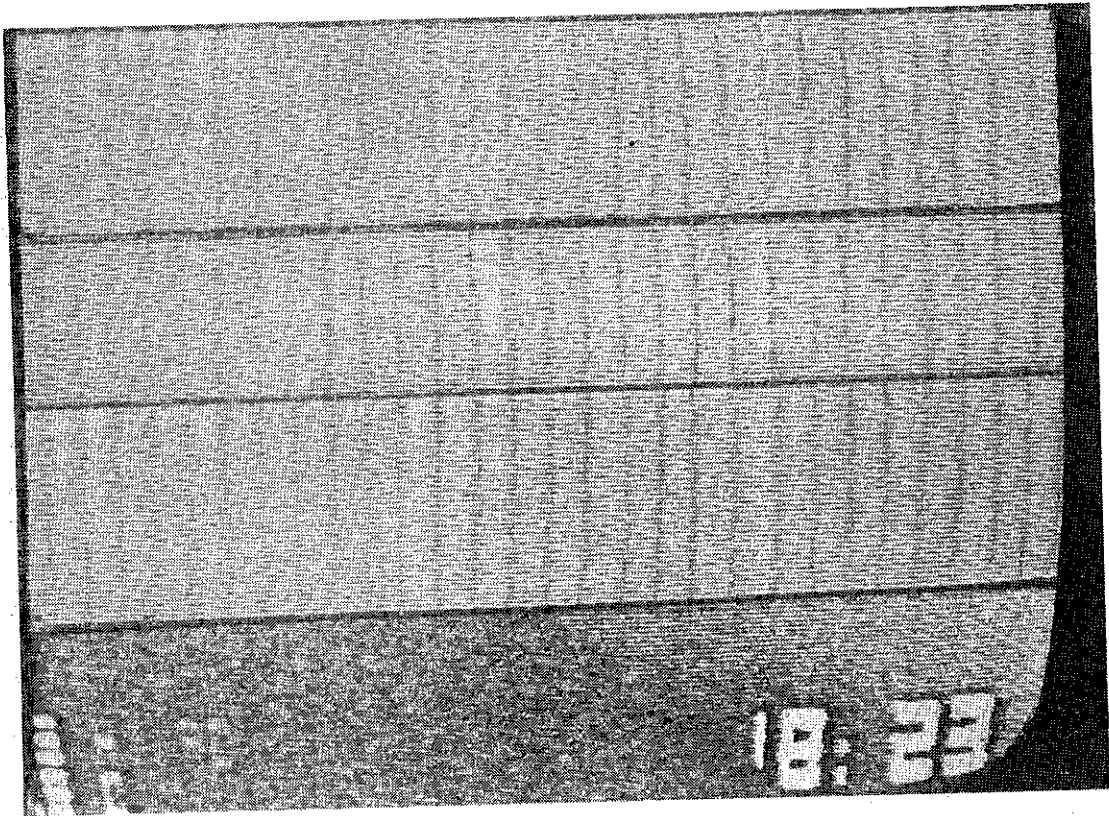
### 2.4 METHOD

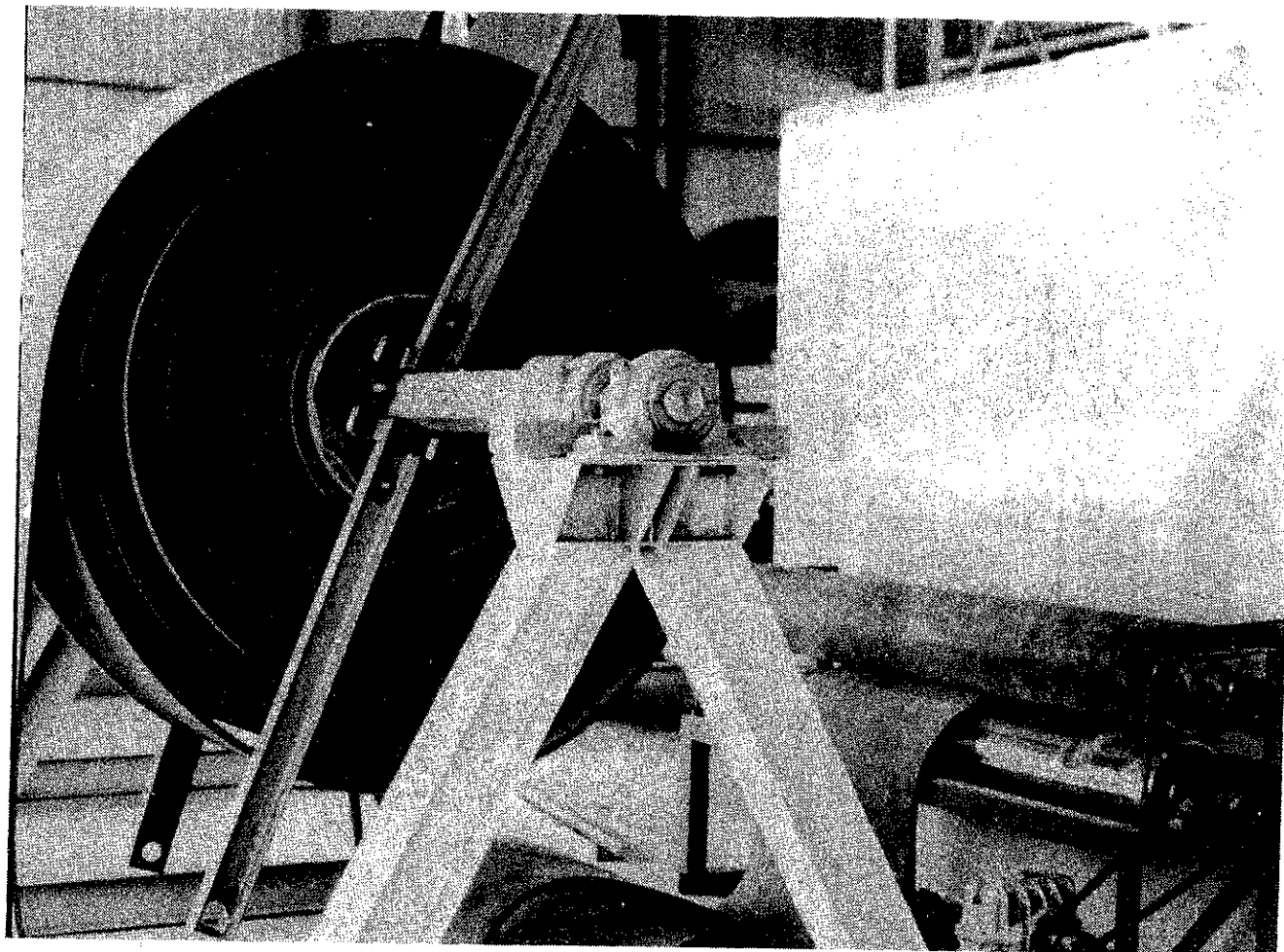
The method consists of either moving the belt through the unit or moving the unit over the belt depending on the need.

It can be installed on the carrying or on the return side to suit conditions.

The image of the carcass is continuously taped during the monitoring process and can be examined frame by frame if necessary, on completion.









With the factory unit a split image on the screen allows visual inspection of the whole belt width in a single pass whereas with the portable unit each pass scans 650mm. Thus for a belt width between 750mm and 1200mm two scans are required. For belt widths between 1350mm and 1800mm three scans, and so forth.

A datum line is used from where all deviations from the norm can be located by measurement for corrective action.

### 3.0 MONITORING FOR PREVENTATIVE MAINTENANCE

#### 3.1 CABLE CONDITION

It is a fact that due to its construction steel reinforced conveyor belting is susceptible to cuts. These occur mostly due to unsatisfactory loading conditions and to a lesser extent from situations arising from a series of conditions occurring simultaneously.

e.g.-a high speed conveyor with excessive sag creates a flow trajectory over each idler set and with, heavy sharp material, the movement of the load on the belt could lead to cuts in the cover.

As the conveyor belt progresses it also undergoes a great change in tension. It is therefore safe to assume that any cut on the cover of the belt transverse to the direction of travel is exposed to these tensions and is open wider in the high tension zone than the low tension zone.

Normally, the low tension zone is the loading point and the high tension zone is the discharge point.

To prevent the passage of fines along the return run of the conveyor system, to cause all the problems that are associated with that condition, a belt scraper is installed at the discharge point.

The belt scraper, besides removing fines from the belt, also forces it into any indentation or hole in the belt. Having passed the belt scraper the cut full of fines returns to the low tension area, where, as the tension decreases, the fines are trapped in the cut increasing the peripheral tension of the cut which, if it cannot exude the fines, increases in size.

This process is repeated cycle after cycle, causing the cut to increase in size and depth.

The basic function of the cover is to protect the carcass, and the compound from which it is manufactured is a combination of properties suitable for a variety of conditions.

Top covers are exposed to the worst conditions in a conveyor system and therefore common sense dictates that the top cover of the conveyor should be the thickest with the ultimate selection being the simultaneous failure of cover and carcass. Steel cord reinforced belting because of its all rubber construction and troughability lends itself to the use of very thick covers.

Where end users have experienced cutting and gouging problems, they have simply increased the thickness of the covers to protect the carcass.

What is happening in effect is that the process by which moisture is getting to the steel cord carcass is being slowed down but the possibility of rust remains and because of the thick cover, deterioration of the carcass must be far advanced before it is visible to the naked eye.

By monitoring the carcass once or twice a year the condition of the steel cords are known. Any necessary repairs can be effected on a controlled basis and the carcass can be kept in full strength condition at all times.

Because of the availability of the information of the carcass, it would be unnecessary to go to the added expense associated with thicker covers, which does not only stop at the price of the rubber.

### 3.2 SPLICES

Splicing of steel reinforced conveyor belting is a specialised operation which not only requires the correct preparation of the cables within the belt, the right sequence of laying them, and the correct method of applying the uncured compound prior to vulcanisation, but also the right temperature and pressure for the vulcanising process.

The old saying "Do Not Judge A Book By Its Jacket" goes for a splice as well.

As ridiculous as it sounds, it is a fact that in a country where approximately 5000 kilometres of belting with a market value of plus/minus R450 M is in operation, there is no institution offering a qualification that can be recognised by a conveyor belt user when employing a beltsman/splicer. Although many conveyor belt users have their own splicing crews, this is not common practice with all of the country's steel cord re-inforced belt users.

Besides the Belting Manufacturers, there are companies offering a Splicing Service to the industry. The real need for Qualified splicers has split their ranks. Their personnel, in many cases not quite up to standard, left them and entered the booming market place as splice contractors in their own right.

Competitive prices exploited by end users led to the demise of many of these mushroom companies and in the death even these partially trained people were lost as Beltsmen/Splicers for two reasons. Firstly the end users found it cheaper to deal with a contractor and secondly, Beltsman/Splicer is not a recognised trade and many of these people have no trades or qualifications.

Unluckily, some of the companies that have survived had to learn bad habits to make their operations pay and unluckier still, well laid top and bottom covers hide these bad habits from view.

Cutting out of cables, complete disregard for cable arrangement and leaving out of inter-cable gum are a few of the malpractices monitored.

These splices are potential causes of unscheduled down time which could lead to costs far in excess of the saving shown by end users not employing their own Beltsmen/Splicers as such.

By monitoring the splices when they are made or as a matter of course, when the belt is done once or twice a year, its integrity can be assessed and if necessary it can be cut out if it shows signs of failure.

### 3.3 COVER PROFILE

Unlike cables and splices the cover profile does not affect the availability of the belt, but by monitoring the cover profile and translating the information, valuable money saving information is gained. The wear

pattern on top of a conveyor belt can point out impact problems, material placement problems and material movement on the belt.

These are all factors which affect cover life if not controlled. Detailed lateral scanning can be done on a static belt using a portable handheld, battery operated unit.

By controlling belt cover wear not only is belt life prolonged but timeous removal of the belt from the structure will prevent carcass damage due to exposure to the load.

Because of the development both in materials and techniques of manufacture, to-day's belting has a longer service life and cover replacement with the accompanying savings for re-using the carcass is the reward for monitoring cover wear.

#### 4.0 MONITORING IN A MANUFACTURING ENVIRONMENT

##### 4.1 HORIZONTAL CABLE DISPLACEMENT

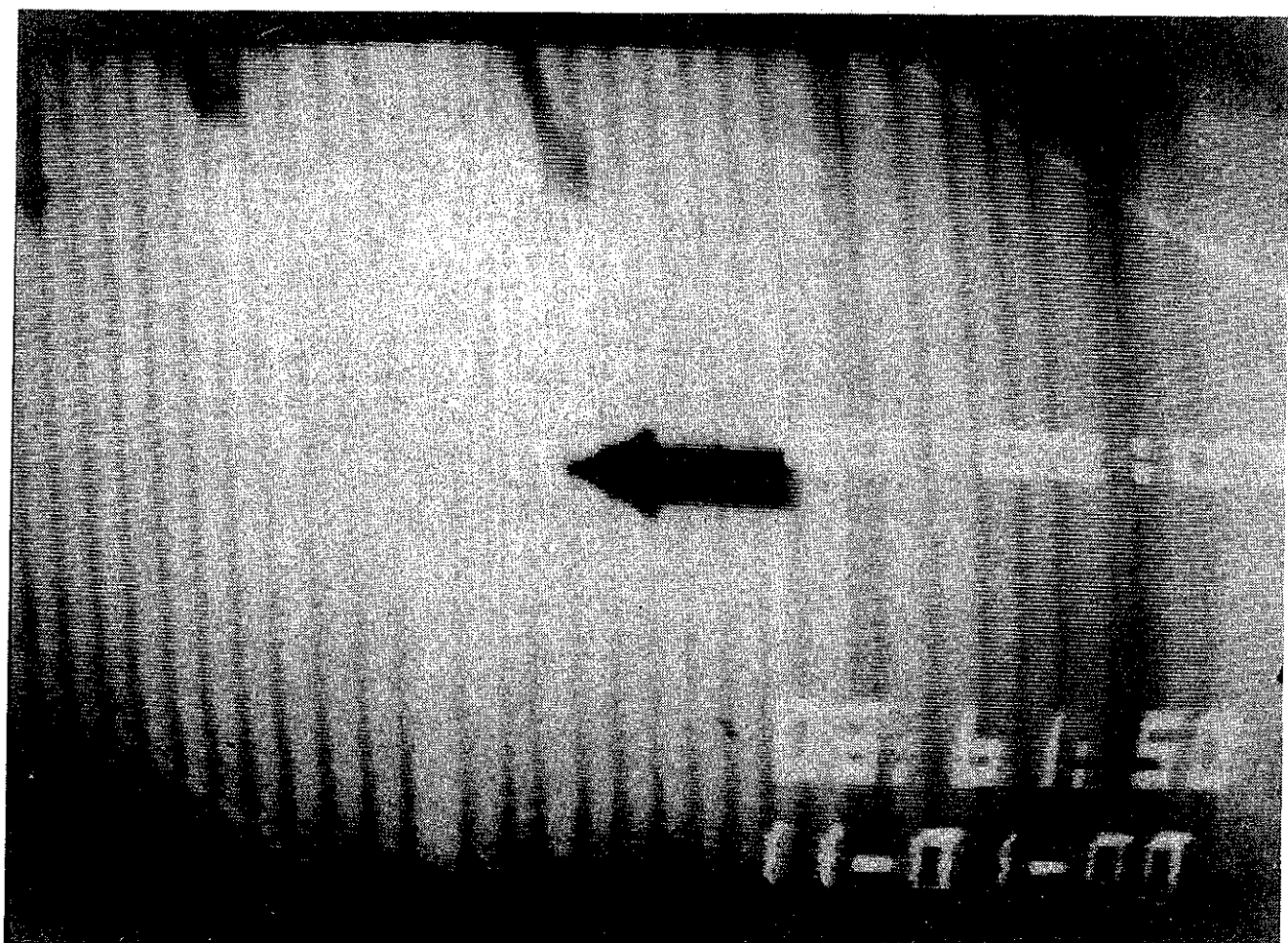
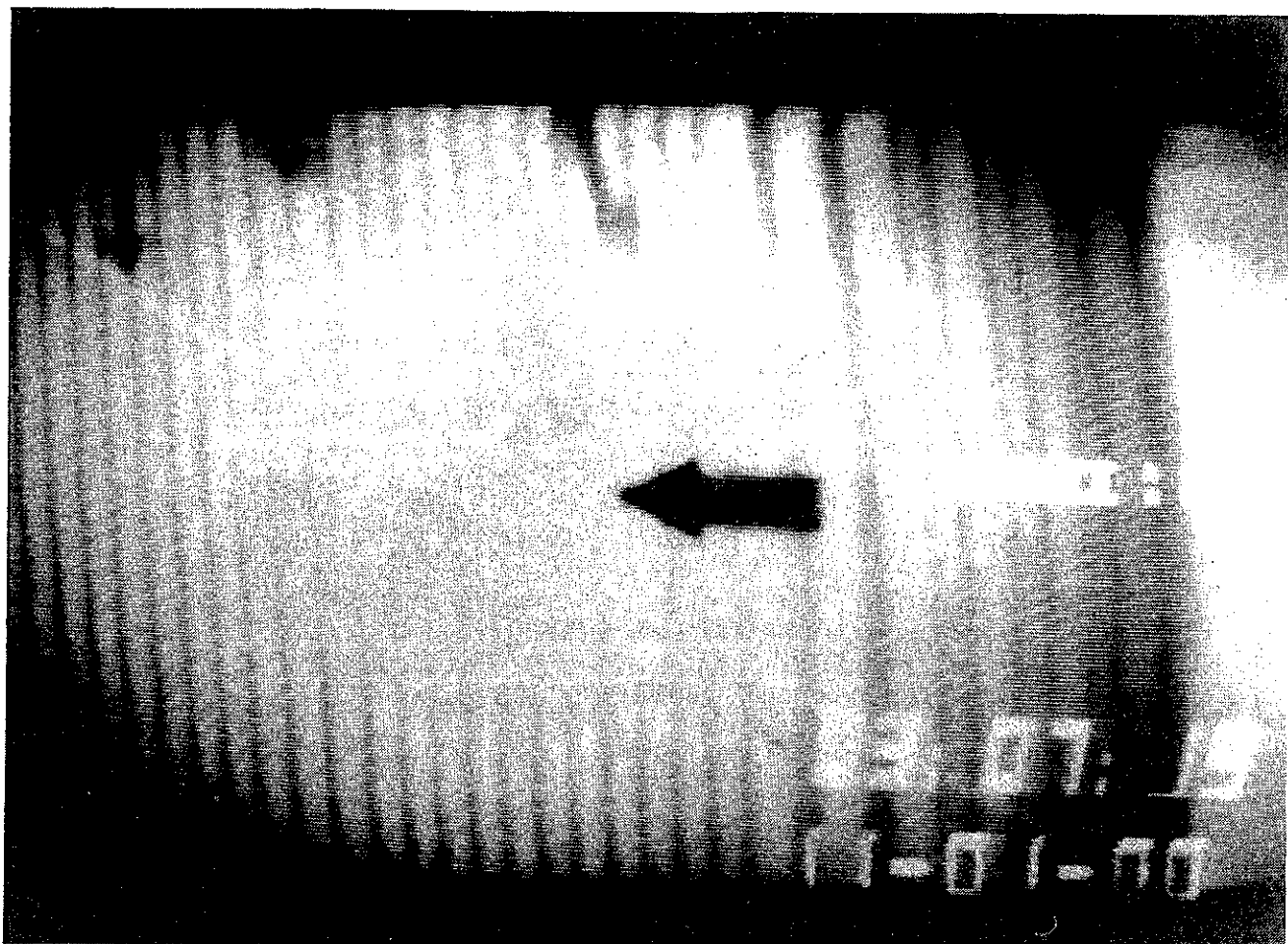
Steel cord re-inforced conveyor belt is manufactured to certain specifications one of which limits the variation in horizontal pitch between cables.

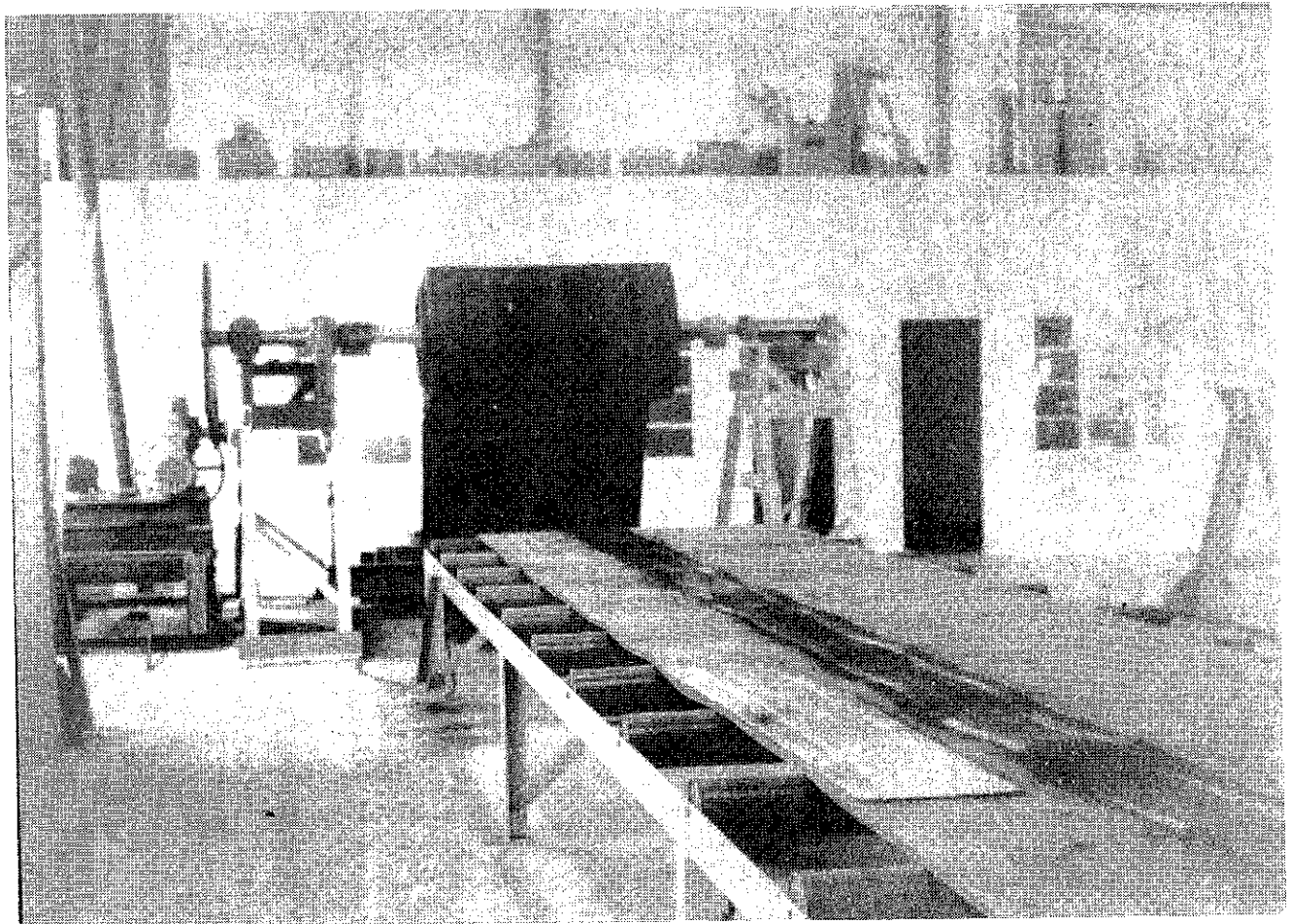
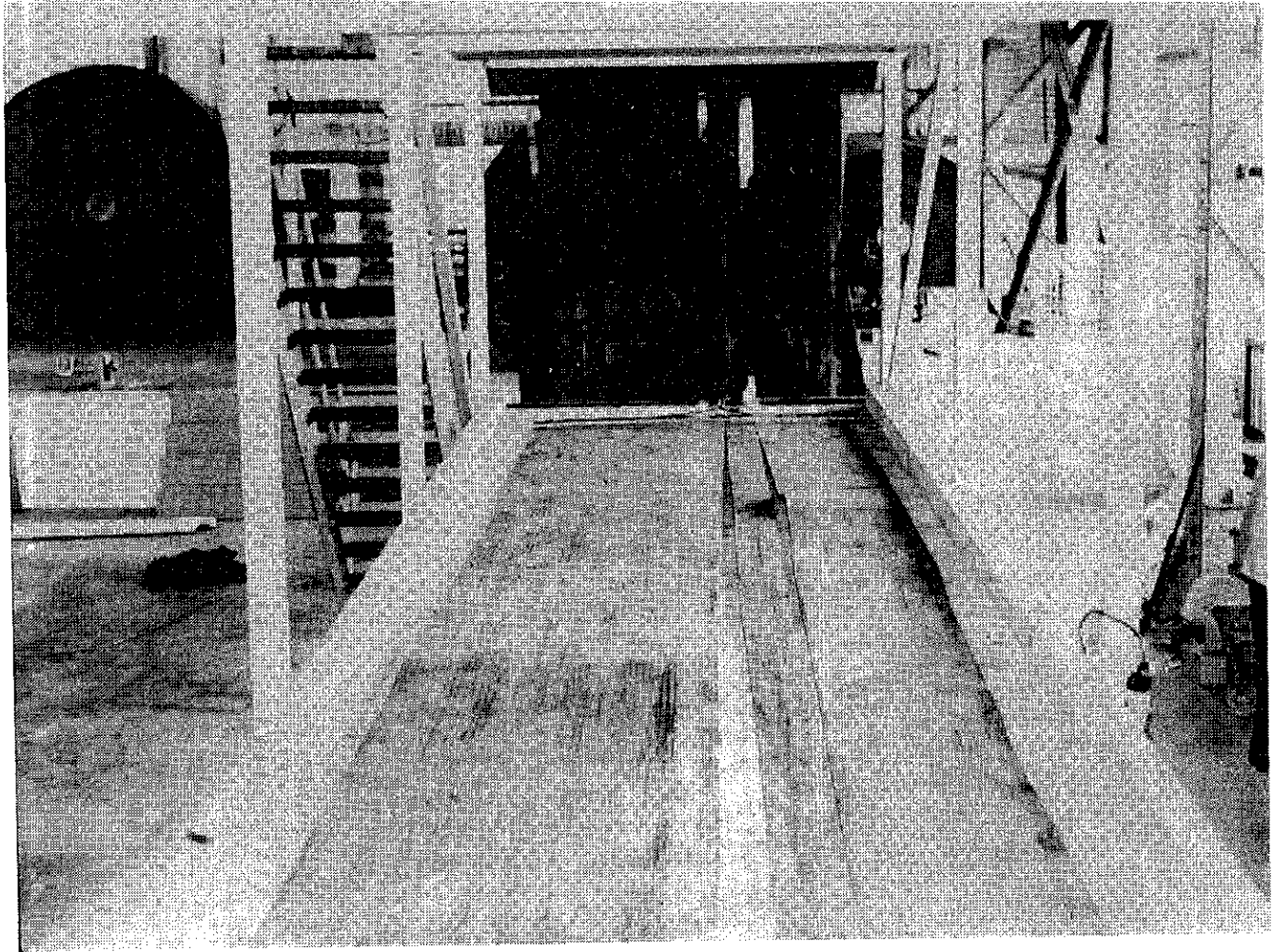
That exceeding the limits as laid down in the manufacturing specifications creates problems, is a fact that must be accepted or else these limits would not have been imposed.

What problems are created and to what extent they affect the satisfactory performance of the belt can only be established by exhaustive tests.

- a) Does the horizontal displacement cause a maldistribution of tensions across the belt?
- b) Does this maldistribution cause training problems?
- c) Is there a breakdown of cable to gum adhesion in these areas?

These are some of the potential problems that can be caused by horizontal cable displacement.





#### 4.2 VERTICAL DISPLACEMENT

Minimum thickness is the norm for the bottom cover of a conveyor belt as its primary function is to resist wear against idlers and pulleys.

Unlike fabric belts the minimum bottom covers of steel cord re-inforced belts depend on the diameters of the cables used for the carcass.

Therefore any downward vertical displacement where minimum covers have been used could very well be detrimental to the performance of the belt. The possibility of the cable being forced through the cover of the belt due to its passing over high tension snubs and drive pulleys is very real.

#### 4.3 CARCASS POSITIONING

If the carcass of a conveyor belt snakes within the sheath of rubber which forms the body of the belt the effect is the same as that which occurs in the case of a dog leg splice.

#### 5.0 MONITORING IN BELT REFURBISHING

##### 5.1 SCOPE OF SAVINGS

As is the case with tyres it is the carcass which costs the money and governs the usability or re-usability of a conveyor belt.

The carcass material used in conveyor belting today together with conveyor design technology relating to the belt itself, like, soft starting and pre-tensioning, means that the inside of the belt will outlast its covers.

Fatigue failure in the carcass occurs when it is stressed to more than 50% of its ultimate strength. (This is a condition which can occur on start-up).

The steel cables are undoubtedly affected by bending stresses but due to the fact that the wires change from the outer to the inner side of the cable within the length of the bend, the bending stress, even by the most conservative methods of calculation is insignificant.

Therefore fractured or rusted cables are two of the most common causes of carcass failures in steel re-inforced belting.

Both these conditions can be detected, identified and corrected during refurbishing.

Should there be any doubt as to whether the other properties such as pull out or breaking strength of the cables, these can be tested by the relevant authorities.

Establishing that a steel re-inforced belt can be refurbished has a further saving in imports as the average cable requirement per metre of belt is approximately 100 metres of cable.

## 5.2 ADVANTAGES OF VISUAL NON DESTRUCTIVE RECLAMATION

In a steel re-inforced conveyor belt the cables are originally protected from corrosion by a galvanised or brass plating. However, the greatest protection is afforded by the insulating rubber in which these cables are enclosed. Exposure of the cables can become a serious factor because of corrosion.

By being able to detect defects visually and being able to decide on the corrective action to be taken, exposure is limited to the affected area and the protection of the cables in the unaffected areas is left intact.

Any defects of a minor nature can be identified and pinpointed for correction by the end user during planned maintenance periods after re-installation.

## 5.3 SELECTIVE RECLAMATION

By being able to do a continuous visual scan on the belt, longitudinal sections, invariably outside the load area, are found to be in very good condition and by selectively slitting the belts lengthwise a number of these salvaged widths can be formed together to join a belt.

This is usually the method adopted in repairing conveyor belting which has been ripped.

## 6.0 CONCLUSION

It would be tragic if the scanner is looked upon as "BIG BROTHER" rather than what it has been developed for, namely, a maintenance/quality assurance tool.

In discussions with belting manufacturers it was found that there was a genuine concern about the non conformances in the belt and certain puzzlement as to their occurrence.

Now that the non conformances can be identified visually, the necessary steps can be taken to prevent them, or lessen the extent to which they occur.

By doing actual tests on belt behaviour out in the field the extent to which deviations from the current specification affect the performance of the belt can be established.