

# Doctor Development and the Need for Efficient Doctoring

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## What is a Doctor ?

A doctor is a carefully engineered product consisting of several parts, namely, a blade, blade holder, support or back, bearings, brackets and oscillation equipment. This combination is designed to meet the individual requirements throughout industries where rolls or cylinders require to be cleaned and conditioned. The first duty of a doctor is to condition the roll or cylinder surface by the efficient removal of dirt, fibre and other deposits. This ensures efficient heat transfer and high surface finishes and also provides efficient sheet take-off in case of sheet breaks and machine feed-up. It is not sufficient merely to clean, but also to condition, the surface of the roll or cylinder, at the same time avoiding scoring, pitting and other damage which would seriously affect the operation of the roll or cylinder.

## Doctor development and the need for flexibility.

The Vickery Doctor, with its free-floating blade, was the original concept of roll doctoring as we know it today. This provided two-way flexibility—that is, with a blade that was free to move in two directions: transversely, so that it could adjust itself to irregularities in the face of the roll and longitudinally, to adjust

itself to changes in temperature when brought into contact with heated roll surfaces. To begin with, it was the spring finger type which became so well-known and widely used on wet end, calender, and super calender applications. The spring finger doctor used thin, flexible blades at light pressures to enable the blade to conform to out-of-round roll surfaces. As machine speeds increased and conditions became more severe, the spring finger type doctor proved to have certain defects. Under modern conditions, it was possible for fibres to pass the blade, edge and build up under the blade, which, in turn, trapped dirt and other abrasive matter causing scoring of roll surfaces. In addition, the individual fingers could be damaged, causing difficulties in blade changing and irregular line pressures at the blade edge.

A later development was the extruded section doctor. This doctor employed the same principle of a free-floating blade, but in a holder designed to permit more positive and uniform application of the blade to the roll surface, overcoming the possibility of fibres passing the blade edge. This design provided controlled flexibility. However, machine conditions continued to develop in such a way as to show up defects in this design, mainly in distortion of the lightweight extruded section. Distortion could occur

not only during operation on the machine but also in the handling of long sections both in transit and in the mill, resulting in deflection of the section.

Ultimately, it was decided that a more universal type of doctor was required to meet a greater number of application needs. The "U" type Doctor ("U" means universal) was designed and is capable of a range of flexibilities to meet every machine condition. The "U" Type Doctor is of heavy construction capable of withstanding use and abuse. It is precision-machined to provide a high degree of accuracy under the most severe conditions. It possesses all the inherent flexibility that is demanded of the modern doctor and offers extreme range of flexibility through different combinations of blade and pressure plate without changing the type of doctor. Sectional construction is a feature of this doctor and is of considerable practical significance to the user. Each section is precision-manufactured to provide complete interchangeability. This means that a damaged section can be readily and inexpensively replaced, avoiding the need to replace the whole doctor. Sectional construction also provides for easy shipping. Individual sections are easily handled and conveniently stocked. Doctor maintenance is thereby reduced to a minimum.

The "U" Type Doctor provides

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controlled flexibility, at the same time giving the advantages of robust construction and the added benefits of extreme accuracy in blade application and sectional construction. Although the doctor is of robust construction' it is designed in such a way as to provide a flat, clean profile.

Recent developments have produced the Inverflex Doctor. This doctor has the same high degree of flexibility, but is designed with the pressure plate under the doctor section, thereby providing protection from the sheet passing over the doctor section under certain conditions and giving self-sealing properties. The Inverflex Doctor also has unique sealing characteristics for wet or dry-end applications. The inverted design produces the self-sealing feature and gives the doctor its name ("Inverflex" means "Inverted Flexibility").

#### **Considerations influencing Doctor design.**

As indicated earlier, a robust doctor blade holder is essential to withstand use and abuse in handling and operation, also to provide strength in the section to resist a tendency to distortion. A smooth and clean profile is necessary to assist effective sheet removal.

Accurate application of the doctor blade to roll or cylinder surfaces is essential. This, in turn, allows for operation of the doctor at greatly reduced blade pressures, providing the following operational advantages :—

1. Longer blade life

2. Maximum roll or cylinder life
3. Reduced horse-power consumption.

Sectional construction is highly desirable. This form of construction ensures accuracy in production and eliminates the tendency to distortion in handling. It also provides the added advantages of interchangeability, eliminating the need to replace the whole doctor. A limited number of sections will cover the complete range of doctors throughout a mill, enabling a complete stock of spares to be held at a relatively low cost. In addition, of course, sectional construction provides for ease of shipping, particularly by air freight and again minimizes costs.

#### **Doctor applications.**

Careful doctor support design and manufacture is essential if the advantages of doctor designs are to be obtained. Each doctor support should be designed to suit the many individual applications. In the design of a support consideration must be given to these main points :—

1. Machine speed and width
2. Position on machine and duty.

There are many different cross sections of supports, including angles, tubes, beams and various forms of fabrications. Consideration must be given in the selection of supports to ensure rigidity minimum deflection stability in operation. In manufacture, care must be taken to ensure that all machined surfaces are accurate to provide correct alignment of journals and doctor mounting. In addition, all natural deflection must be machined out of the support in its working position. In support

application it is usual to design for self-loading, but in certain cases on wider, fast machines, it is advisable to design for air loading.

#### **Blade material selection.**

In the selection of blade materials for any doctor application the following points must be considered :—

1. Material to be sympathetic to the roll or cylinder surface.
2. Material must be resistant to particle pick-up.
3. Material must be flexible.
4. Uniform quality is essential for controlled doctoring.
5. Wearing properties of blade material must be closely investigated to provide maximum life and a clean cutting edge.

Various types of material are used in blade manufacture. The most widely used are carbon steel, stainless steel, bronze and composition (resin-bonded linen). Quality control in manufacture is important to maintain set standards which bear directly on the efficiency of doctoring. Controlled hardness of blade material is important. For instance, in the selection of carbon steel material we would recommend a hardness of 52° Rockwell C, with negligible variation from this figure.

#### **Operation of Doctors.**

In order to obtain the best possible results from a doctor which has been carefully engineered to provide efficient doctoring, it is important that the user observes the following points :

1. Careful selection of blade materials.

2. Accurate alignment of doctor against roll or cylinder surface.
3. Correct angle of application. It is important that the doctor should be set to the correct angle—this is easily achieved by using the angle gauge supplied for the purpose.
4. Immediate replacement of damaged blades or pressure plates.
5. Periodically, the doctor installation should be checked for cleanliness by the machine crews,

It should be understood that a doctor is designed to operate under widely varying conditions and the best results will only be achieved if a regular maintenance programme is followed.

#### **Doctor oscillation.**

In many cases it is necessary to oscillate doctors—for instance, on press rolls, 1st drying cylinders, M. G. or Yankee cylinders, dryers after size presses and coating stations, cooling cylinders and calender rolls. In some cases, oscillation would be recommended on breast rolls and wire wash rolls. There are several types of oscillators, mainly electro-mechanical, fluid and pneumatic. It is essential for good doctoring to have a smooth, continuous oscillation at speeds between 10 and 25 strokes per minute, depending on the application. Normally, the length of stroke would be 20 mm. The reasons for oscillation at the wet end of the machine are usually to prevent fibre particle build-up at the blade edge, thus preventing roll scoring and blade edge passing, while

in the case of cylinder applications, the movement of the doctor creates a shear action, therefore assisting the blade to cut through any deposits and avoiding the possibility of cylinder scoring, in addition to ensuring a clean, polished surface. In calender applications the shearing action referred to above assists the doctor blade in cutting underneath the stamps deposited on the rolls, eliminating scoring and sheet marking. Oscillation in this instance also assists in sheet take-off.

#### **Advantages to be gained from efficient doctoring :**

At the wet end extended wire life can be obtained by the efficient removal of fibres from roll surfaces. Unless fibres are continuously removed from roll surfaces, ridging of the wire is certain. This, in turn, will cause cracking and surface irregularities in the wire. On the presses, high surface finish is essential for quality paper making and it is important to reduce breaks to a minimum. This is achieved by the prevention of fibres and water passing the blade edge. On the cylinders, high surface finish ensures a greater degree of heat transfer and a clean sheet surface. In the case of M.G. or Yankee Cylinders, efficient doctoring provides high quality surface finish and effective sheet removal at feed-up. At the calender section, the removal of stamps is essential. Efficient doctoring assists in this, thereby maintaining uniform paper quality. In addition, high surface finish on the rolls will provide a better sheet surface condition.

To sum up, we quote the case of a mill making banks and bonds on a 4 m. wide machine running at speeds up to 350 m. per minute. Wire life was increased from 9 days to 21 days on a regular basis through the installation of complete doctoring equipment on breast roll and wire rolls in replacement of older type doctors. This change provided the mill in question with a saving of \$25,000.00 a year. We also quote the case of a mill making fine papers on a machine 5 m. wide running at speeds up to 400 m. per minute, where blade life was increased from 3 weeks to 15 weeks and the horse-power consumed by the doctor in a cylinder section reduced by 75%. In terms of 20 cylinders, this effected a saving of as much as 60 h. p. In addition to the increased efficiency of doctoring, the saving in doctor blades and horse-power is considerable.

There are many cases, such as these, which confirm the economic advantages to be gained by the application of efficient doctoring equipment. "Prevention is better than cure". This saying is particularly apt on the paper machine where bad doctoring can quickly and imperceptibly lead to the expense of regrinding, recovering or in some extreme cases even replacing the rolls or cylinders. The capital tied up in doctored paper machine "rolling stock" presents a considerable proportion of the overall machine cost. However, the importance of good doctoring is in many cases not fully appreciated in this light.