

Conference contribution:

The Choice of the Most Suitable Slitting System for Slitting Thin Aluminium Foils

Referent:

Mr. Hermann Jeremies, DIENES Werke

Agenda

- 1.0 Preface
- 2.0 Slitting Technology
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Welcome to my lecture on the longitudinal slitting of thin aluminium foils.

With this lecture, I would like to present two slitting systems to you – the razor blade and the shear cut system – and I will draw up Dienes' solutions for an efficient increase of productivity.

I would like to point out that slitting technology has made major developments in the last years and that due to the application of special tools to achieve individual slitting demands, the performance regarding cutting speed, cutting edges, dust formation and knife service life could be improved seriously.

In most of the existing slitting machines, there is a high potential for cost reduction and improvements which can be realized with today's technologies.

First, however, allow me to introduce (myself and) our company to you in brief:

(My name is Hermann Jeremies and I am working for Dienes since 1984. First, I was in the construction department, responsible for slitting tools, and since 1997 I am working as technical sales engineer.)

The name Dienes stands for innovative developments in industrial slitting. We have a number of German and international patents for our products.

Since its foundation in 1913, DIENES has been producing circular slitting tools. Our present production comprises knife setting systems, knife driving systems, pneumatic knife holders, top and bottom knives of different shape and material.

Our customers are not only the aluminium processing industries, but others as well. Our products are used where wide material webs are to be cut into narrower webs for further processing.

The following production plants are part of the DIENES Group:

- **DIENES Corporation** with the same product range as the Dienes parent company
- **Euroknife**: production of circular knives
- **Neuenkamp**: specialized on the production of rotary shear knives
- **And the company Johann Krumm**: specialized on the production of straight knives

Worldwide, 500 Dienes employees are at your service.

Due to the limited time, today it is only possible to give a short overview of the main issues. However, I will be at your disposal for further discussions after this lecture.

1.0 Preface

For slitting aluminium foil, the following slitting systems are applied:

- razor blade cut
- shear cut
- rotary shear cut

The choice of the slitting system depends on the material specifications, the cutting speed and the material thickness.

Although all slitting methods are completely different, they have to meet the same requirements, however. These are among others:

- precise cutting edges
- reduced dust formation
- exact roller surface
- slitting of one or more layers
- minimum burr formation
- avoiding the deposit of particles on the cutting edge
- avoiding wavy cutting edges
- avoiding markings on the material web

According to our experiences, there are no defined parameters for the choice of the slitting system.

The parameters

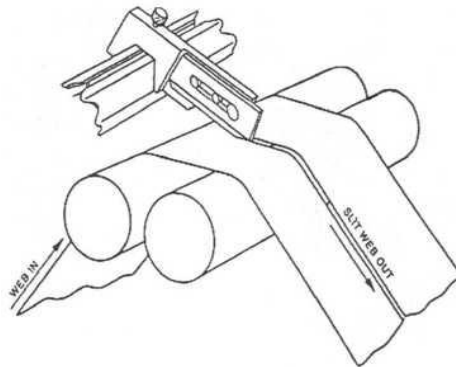
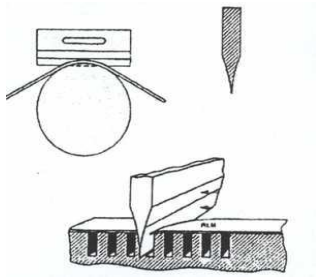
- material quality
- material thickness
- cutting speed
- single or multi-layer slit
- adjustability of the cutting point
- knife holder quality
- and others

are taken into consideration, the limits are fluent, however.

The following reference values are the results of practical experience:

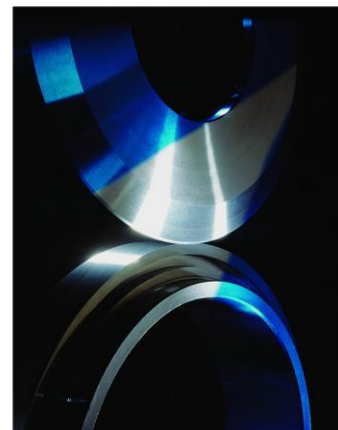
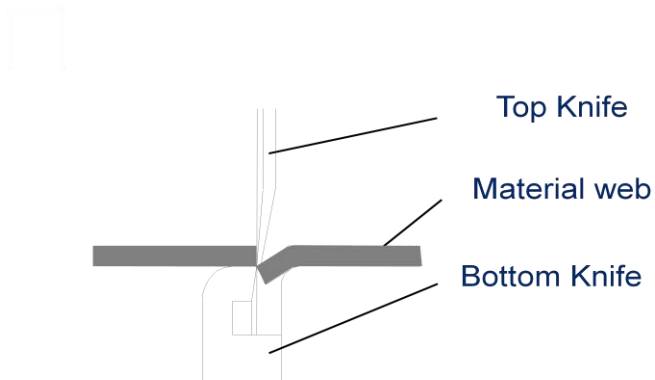
a. Razor blade cut system:

A fixed blade dips into the material web in a flat angle.
 The web is supported by a grooved bottom knife shaft (see drawing A) or by two guide shafts which are assembled close to each other.
 The cutting speed is between 600 and 1200 m/min.
 single or multi-layer, up to a thickness of approx. 20 µm



b. Shear cut system:

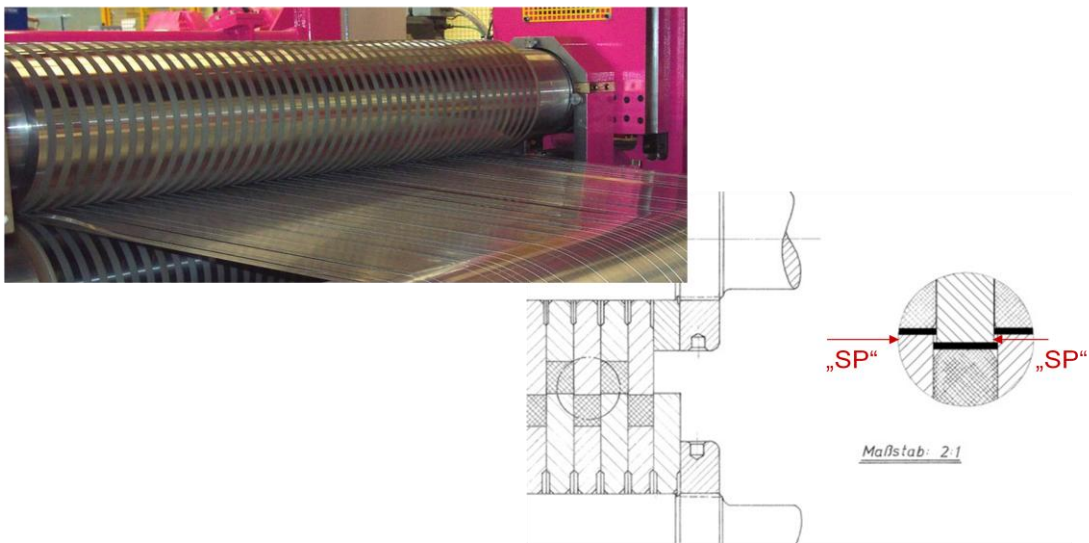
A spring-loaded top knife rests against a rigid bottom knife.
 The material is cut by the top and bottom knives overlapping each other.
 The cutting speed depends on the cutting width and the construction of the knife holder.
 single or multi-layer, from a thickness of approx. 12 µm



c. Rotary shear cut system:

The material is separated by two slitting edges with a defined slitting gap "Sp".
By using rubber stripper rings, the material is led over the rotary shears.
At the same time, the slit strips are pushed out between the rotary shears.
Spacer rings fill the space between the knife shafts and keep the slitting width.

This rotary shear cut system, which we will not discuss today, is applied for material thicknesses from 400 µm and thicker.



2.0 Slitting Technology

2.1 **Blade Cut / Knife Holders**

As already mentioned, the blade cut is preferably applied for cutting single or multi-layer foils up to a thickness of approximately 20 µm.

Besides the blade thickness, the most important criteria for a clean and burr-free cut are the blade setting angle to the material web, the guidance of the material web and the position of the cutting point. The best slitting results are achieved when the material web is led over grooved multiple knife blocks at a high wrapping degree. The cutting point should then be at approx. two third of the total wrapping. A free cut between two web guiding shafts may be less expensive, however the web fluttering has a negative influence on the cutting edge quality.

On the following picture, you see a state of the art blade cut holder which is used for cutting speeds of up to 1200 m/min.



Typical for this blade holder are:

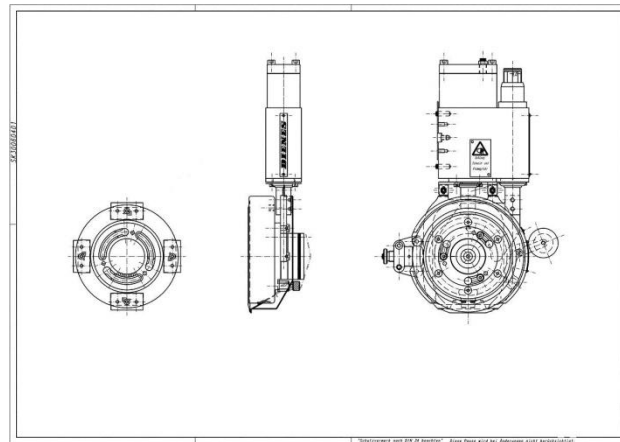
- a. movement-free, vibration-absorbing double guiding for the vertical lift
- b. quick-change blade head, exchangeable for shear cut knife head
- c. adjustable blade setting angle (max. 60°)
- d. scaled depth adjustment
- e. knife lubrication for avoiding the deposit of particles on the cutting edge (only for shear cut)
- f. 360° special hand guard
- g. adaptability of the knife holder to any machine
- h. overall dust protected knife holder
- i. sealed against kerosene, petroleum and paraffin
- j. mechanical or laser-supported adjusting help type "easy set"

This picture shows the Easy Set Adjusting Help. The buffer is swung into the gap of the bottom knife. Then the knife holder is fixed and the buffer is swung up again.

2.2 Shear Cut

As already mentioned, the limits of material thickness which decide whether to apply either the blade cut or the shear cut system are gliding. This is the reason why knife holders are equipped with a vario knife head. This vario knife head allows the knife holder to be re-equipped from razor blade cut to shear cut within a very short time.

This drawing shows a shear cut knife holder with vario head



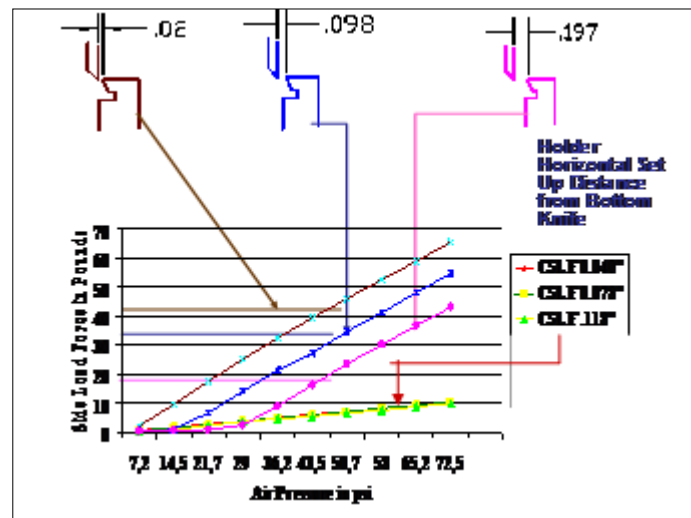
The knife holder with the shear cut head combines a series of detailed developments which allow to slit at a speed of 2000 m/min.

Furthermore, DIENES has developed the patented CSL (constant side load) technology. Knife holders with this CSL function of the cutting-head grant that the once pre-adjusted knife contact force remains the same throughout the complete range of the axial knife stroke.

Length alternations of the cutting shaft due to thermal influences – as for example in roll stands – can be balanced without any problem. Knife heads with a maximum axial lift of 6 mm are available.

I will come back to the demonstration of the CSL Technology later.

In this diagram, the different contact forces of conventional knife holder types compared to the contact force of the CSL knife head are clearly visible.



- 1. Consistent knife life for all holders**
- 2. Longer knife life by a factor of four - six**
- 3. Reduced blade regrind costs**
- 4. Less operator set-up time**
- 5. Sustained vibration resistance**
- 6. Less holder component damage**
- 7. Superior, sustained slit edge quality**
- 8. Substantially less dust over time**
- 9. Minimal holder maintenance**

2.3 Shear Cut with Motor-driven Knives

In this case, the task is to separate two layers of aluminium foil of 12 µm up two layers of 60 µm. The following requirements have to be met:

- using the razor and the shear cut system
- minimum set-up times
- optimum slitting edge quality
- increased knife service life
- increased slitting speed from 800 m/min. to 1500 m/min.

With the shear cut system with driven top and bottom knife shafts that was used till now, these requirements could not be realized.

On the other hand, it was not possible to do without a driven top knife due to the low material stability of the very thin aluminium foils.

As a result, a motor-driven knife holder was specially developed to the needs of the aluminium manufacturers and aluminium processors.

This picture shows the motor driven knife holder.



- **With frequency-controlled servo motor for the knife drive**
The speed of the knife can be adapted exactly to the speed of the material web - even with reground knives and a maximum overspeed of up to 10%.
Depending on the material thickness and the web speed, the optimum overspeed is between 0 and 3%.
- **With “CSL” technology**
The axial contact force is controlled by the respective air loading of the knife head.
Depending on the thickness and solidity of the material to be slit, the contact force can be adjusted precisely.
Minimum contact forces increase the service life.
This is the decisive advantage: always to have the optimum slitting conditions independent of the operating conditions – (even at boundary conditions).
Foil of approx. 40 µ are slit up to a speed of 1500 m/min. at an operating pressure of 1,5 bar. This corresponds to an axial contact pressure of 15 N!
- **Cutting point**
The construction of the knife head grants that the top knife is always maintained in a rectangular position to the bottom knife edge. Therefore the top knife cannot tilt.
- **Possibility of regrinding**
The regrinding range of the top knives is between a Ø of 150 and 140 mm. The individual overlap adjustment of each knife holder allows to do without regrinding steps when using knife shafts.
- **Shear angle**
When applying the shear cut, the shear angle usually is 30'. For the razor blade cut, this angle is set back to 0'.
- **To avoid the deposit of particles on the cutting edge** Dienes recommends polished top knives and additional knife lubrication.
The knife lubrication is constructed in a way that the cleaning felt follows the lifting movement (up to 6 mm) of the top knife almost without any friction.
The necessary liquid quantity is exactly supplied to the felt by a valve, a timer and a distributor.
- **Equipment of the bottom knife shaft**
The multiple knife blocks are constructed in a way that they can be used for both slitting systems.
In order to avoid markings on the material web, the complete bottom knife shaft, that is equipped with knife blocks, was ground on the outside diameter.

This high-tech knife holder meets all the before mentioned requirements to improve the slitting results. This knife holder should preferably be applied computer-supported.

On the displayed picture, you can see this high-tech knife holder.



This tool has been developed especially for the aluminium foil industry for new and already existing machines to increase the productivity.

3.0 Resume

The experiences of the past years have showed that it is not possible to choose the optimum slitting tool as well as the proper slit width adjustment system for new and existing machines without the support of a professional company.

Dienes, as one of the leading slitting tool manufacturers, has the necessary know-how and experiences. This is what makes us experts in terms of consulting and implementation of your slitting system.