

# NIP FORCE MEASUREMENTS

## The most important questions

Nip force measurements are the most important part of a press nip study. They create the basis for troubleshooting and optimising your nip process. We will investigate if there is more capacity and will help you to improve your runnability, paper quality and energy efficiency. Our specialists have an experience of over 200 individual measured and adjusted nips worldwide.

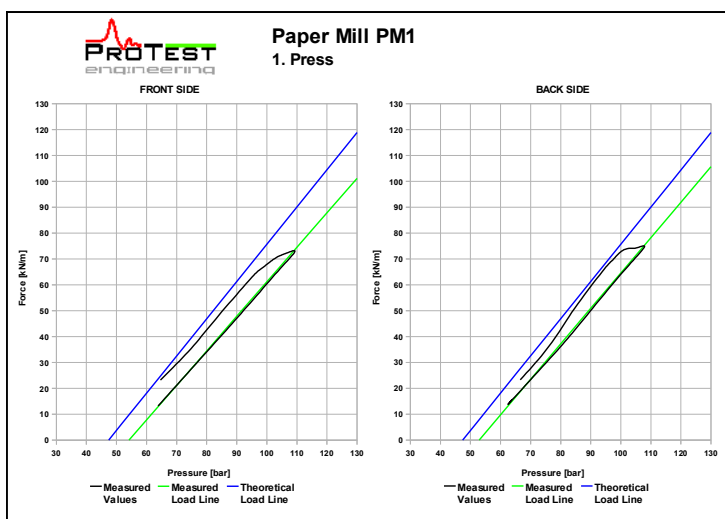
### What is a nip force measurement?

Nip force measurement is a nip condition test package done in a machine shutdown.

With the measurement, we will define at the same time front and back side actual linear load [kN/m] as a function of loading pressures [bar]. This is done by means of two load cells and two to four pressure sensors. The force is measured between nip roll bearing houses. Special load cell brackets are used to hold the load cells in correct position. Normally, at the same time with the nip force measurement, we will make a hydraulic/pneumatic nip loading system function tests with a multi-channel pressure analyser.



### What are the typical findings?



Some typical findings are:

- press nip loading mechanics friction exceeds allowed limit and this will have a negative effect on actual linear load level. Nip controllability and sensitivity can be poor. Actual linear load level can also be wrong because of inadequate theoretical calculations, wrong nip control software parameters, wrong operator panel programming or because of problems in the nip loading system hydraulic/pneumatic components.

- difference between front and back side due to difference in loading mechanics friction, inadequate theoretical calculations, wrong nip

control software parameters or problems in the nip loading system hydraulic/pneumatic components.

- linear load control and pressure rampings can be very unstable because of problems in the control components. Sometimes other mechanical components, such as suction roll saveall or suction pipe has a undesired force effect on actual linear load.
- with ProTest engineering specialists and measurement equipment all problems mentioned above can be found and solved.

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### **What kind of further actions can be done according to the measurement results?**

Performed by ProTest engineering, nip force measurements gives immediately information on the need of further actions such as:

- nip loading system mechanical service (normally includes changing of loading arm pivot pins, bearing sleeves and loading cylinders/bellows)
- reprogramming of nip loading curves to automation system / operator panels
- adjusting of hydraulic/pneumatic component functions
- changing of problematic components such as pressure control valves

With the measurement results, it is possible to adjust actual linear loads right away, so that nip loading is correct and even between front and back side.

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### **What kind of measurement system does ProTest engineering have?**



ProTest engineering measurement system is a state-of-the-art full digital force/pressure measurement system. Digitality means disturbance free measurements. The system is high sensitive, very accurate, and it is calibrated periodically in a certified laboratory. The software is self made specially for paper machinery nip analysis and nip adjustments.

The system allows us to make accurate measurements from very low (<10 kN/m) to high (>100 kN/m) linear load levels.

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### **What type of nips it is possible to measure?**

ProTest engineering nip force measurement is suitable for all type of nips with external cylinder/bellow loading. We have measured many different type of press nips, size press nips, calender nips etc. The measurement is even applicable for coating station beam force measurement

and reel nip force measurement. The measurement is applicable for both hydraulic or pneumatic loading systems.

### How can we improve paper machine energy efficiency with the nip force measurements?

The dryer section is the highest thermal energy consumer on the paper machine, so optimizing energy efficiency can help to cut operating costs.

For example, if press section linear loads are found too low, we can adjust them back to original design values to gain more sheet dryness after press section. This can lead to a significantly lower steam consumption in the dryer section, or potential to increase machine speed.

Optimal nip operation also usually means better runnability with less sheet breaks and easier tail threading. This improves the machine efficiency and at the same time energy efficiency.

### What is the pay-back period for measurement costs?

There has been cases, where pay-back time for measurement costs is only one day!

In these cases the findings were significantly low nip linear load levels. After the correct adjustments, we have really improved the dryness after the press section and this leads to higher energy efficiency. Quite often, nip force measurements pay-back time is less than one year.

See below a example calculation from a paper machine case after nip optimisation. In the calculation, parameter "steam consumption per water evaporated" is an estimated value on modern machines according to TAPPI technical paper 0404-33 "Dryer section performance monitoring".

#### Steam consumption calculation

|  |                               |                               |                 |
|--|-------------------------------|-------------------------------|-----------------|
| Dryness at reel [%]  | 97,3                          | Steam price [€/t]             | 38              |
| Dryness after press section [%]  | 41                            | Production hours per year [h] | 8000            |
| Dryness after press section [%]<br>(after nip optimization)              | 41,2                          |                               |                 |
| Grammage [g/m <sup>2</sup> ]   | 80                            |                               |                 |
| Web width [m]  | 6,3                           |                               |                 |
| Machine speed [m/min]  | 1100                          |                               |                 |
| Steam consumption per water<br>evaporated [kg steam/kg h <sub>2</sub> O] | 1,3                           |                               |                 |
| Production [t/h]   | 33,26                         |                               |                 |
| Steam consumption [kg/s]   | 16,49                         | =                             | 475042 t/a      |
| Steam consumption after nip<br>optimization [kg/s]                       | 16,36                         | =                             | 471057 t/a      |
|  | <b>Steam saved every year</b> |                               | <b>3985,4 t</b> |
|  | <b>Money saved every year</b> |                               | <b>151444 €</b> |

### How often should the nip force measurements to be done for the same machinery?

This is a machine dependent parameter and is effected by many factors like quality of pivot pin greasing, hydraulic oil purity, environment (water, chemicals, heat) etc. There is no right answer.

Some mills organize the measurements only after they have some problems and some mills organize the measurements every 1-2 years just to check that everything is ok. Our opinion based on a long measurement experience is, that nip force measurements should be done every 2-3 years. And of course right away, if problems arise. It is very important to act, before problems get worse.

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### **Is it possible to arrange a larger nip study, not just nip force measurements?**

Absolutely. Quite often the nip force measurement is a part of a larger nip study. The nip study can include for example detailed analysis of a loading hydraulic system, nip force measurements and finally electrical nip profile measurements to adjust the nip CD pressure profile by means of fixed crownings and deflection compensated rolls.

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### **How many hours of shutdown time does it take to complete nip force measurements?**

It is important to understand two different things here: 1) fitting the load cell brackets 2) making the measurements with possible corrective actions. Normally, the customer fits the load cell brackets according to ProTest engineering advices. It is hard to estimate this fitting time, but very often, for example with a three nip press section, it has been between 6-12 hours. If there has been previous measurements with the same rolls, fitting time is quicker. Completing the nip force measurements requires normally 2-3 hours per nip including possible corrective actions. This is an estimation, when everything goes as planned. Note! Because of safety reasons, measurements can start only when all the brackets have been fit and roll drives locked.

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### **Does nip force measurements require special knowledge?**



Yes, a lot. To make safe measurements and to get the correct results and to be able to do the right corrective actions requires years of testing experience with different kind of nip loading systems.

ProTest engineering specialists have the best knowledge to complete safe and reliable measurements.

### **Where to get more information on testing different kind of machines and positions?**

Please check ProTest engineering contact information from our website [www.pte.fi](http://www.pte.fi). You can find contact information from this brochure, too. We serve our customers in english and in finnish.