Core / Chuck Interface Guidelines for Winding and Unwinding
Tubes and Cores

INTRODUCTION

This guideline is recommended for manufacturers, users and purchasers of paperboard cores and winding/unwinding chucks. Its purpose is to assist in the selection of chucks and cores, their dimensions and applications. In addition it may be used as a trouble-shooting guide or simply to improve a process.

OBJECTIVE

The objective of this guideline is to provide information to help identify the relationship between the core / chuck interface and the relationship to runability and core chew-out failures.

DETERMINING THE CORE CHUCK INTERFACE

A. Core-Chuck Interference (T-157)

As the paperboard core is a viscoelastic member, it is critical that the chuck supporting and driving it have a proper interference fit (see CCTI test T-157). If this interference is not great enough, then the capacity to transfer loads is diminished. In the case of a marginal interference, there may be a temporary operating time followed by a breakdown in the inner plies of the core. Typically, the cyclic loading (due to rotation) will breakdown the core steadily and in a poorly matched chuck-core interface, there can be a catastrophic failure.

B. Inner ply(s) strength/properties

The inner ply strength is important when "chew-out" or "spin out" (see CCTI testing procedure T-156) are of concern. In the case of a chew-out, the inner ply(s) may be too weak to withstand the torsional forces exerted by the chuck and consequently the inner ply(s) is partially or fully delaminated. In this case a stronger inner ply would be required.

In the case of a spin out, the chuck would slip on the core usually during periods of acceleration or deceleration. The inside of the core would show no sign of physical damage except possibly surface scoring or burning. As it applies to inner ply strength, this ply is too hard and/or too smooth, a softer and/or rougher inner ply(s) is necessary.

Refer to TAPPI test methods for internal bonding strength of paperboard, sheet smoothness and surface hardness.

C. Chuck type

- Fixed: conical, serrated,
- Expanding: pneumatic,
- mechanical, passive
- More ????

DETERMINING OPERATING CONDITIONS

A. Chuck insertion and interference
Determine the actual insertion depth and chuck interference (see CCTI test T-157).

**B. Roll weight**

Determine the conditions of the greatest roll weight and the weight at the time of concern. Due to speed issues, it can happen that the weight of concern is less than the maximum. For example, on windup, the rotational speed will be higher prior to the diameter associated with max load.

**C. Press/winder speed**

As with roll weight, it is critical to determine the speed at the time of concern.

**D. Braking Time**

Determine the actual time from full speed and full diameter to complete stop in an emergency stop situation (see CCTI test T-155, Chuck Torque). This will allow a rough brake torque measurement (see Calculation section); however, if there is a way to determine instantaneous braking speed or brake torque, it may show a higher value.

**Matching Cores to Chucks**

Specifying the chuck and designing the appropriate core typically require experience and on machine testing. The main design considerations include but are not limited to:

- Interference recommendations
- Core ply and ID recommendations
- Chuck recommendations
- Braking recommendations

**CALCULATION**

Presses and roll stands accelerate to speed and decelerate in braking through the application of torque from the cores. As this interface is between steel and paper, it is a potential weak link. Overloading torque results in the chuck rotating with respect to the core and this is referred to as chew-out. The torque applied to the core by the chuck typically reaches a maximum during E-stop (emergency stop) deceleration and this is calculated the following way.

\[
Chuck\_Torque = \frac{m_{roll}D_{roll}V_{web}}{4T_{braking}}
\]

where:

- \(Chuck\_Torque\) = Torque (N-m)
- \(m_{roll}\) = mass of the roll (kg)
- \(D_{roll}\) = Roll diameter (meter)
- \(V_{web}\) = Roll speed (meter per second)
- \(T_{braking}\) = Deceleration time (seconds)

If the torque given by your press exceed the Chew-Out torque resistance of your tubes or cores, you may have Chew-Out problems. Refer to the CCTI test procedure T-156 for more information.

To calculate the braking torque in English units use:

\[
Chuck\_Torque = \frac{w_{roll}D_{roll}V_{web}}{48T_{braking}g_c}
\]

where:

- \(Chuck\_Torque\) = Torque (ft-lbs)
- \(w_{roll}\) = weight of the roll (lbs)
- \(D_{roll}\) = Roll diameter (in)
- \(V_{web}\) = Roll speed (ft/sec)
T_{braking} = \text{Deceleration time (seconds)}
\quad g_c = \text{gravitational constant} = 32.2(\text{ft/sec}^2)

N.B. 1 Newton-meter = 0.7373 Ft-lbs

CONCLUSION