

CONTINUOUS DRYING - WESTERN CANADIAN EXPERIENCE

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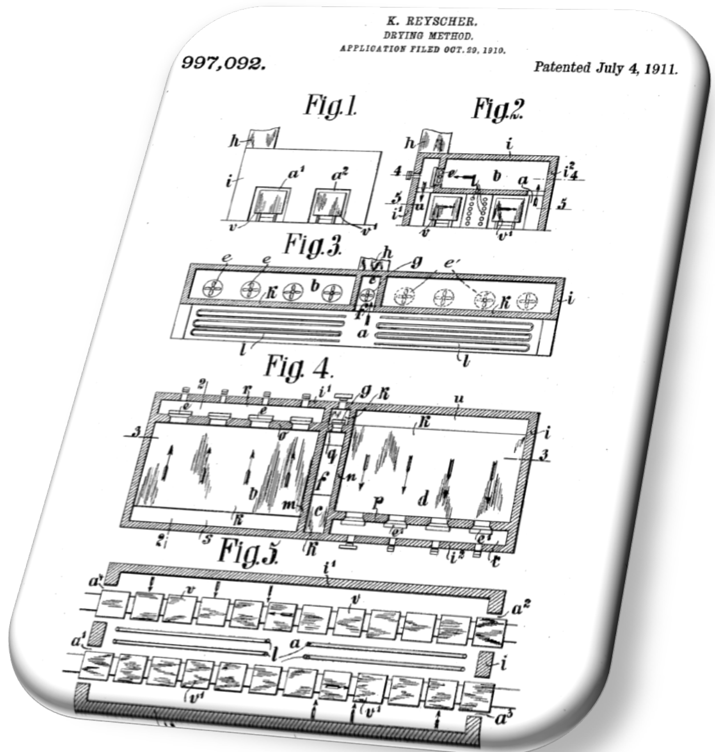
FPInnovations

BRIEF HISTORY



- The first patent dates from 1911 (Reyscher)

BRIEF HISTORY

- A different concept design was formulated and adopted in USA starting with 2005 -Triple-Length Continuous (TLC) Dry Kiln
- US 2005 Pollard Lumber- open end design 80/80/80
- Canada 2013 Weyerhaeuser Drayton Valley, Alberta 49/109/49
- Today 100+ sold in North America

DESIGN

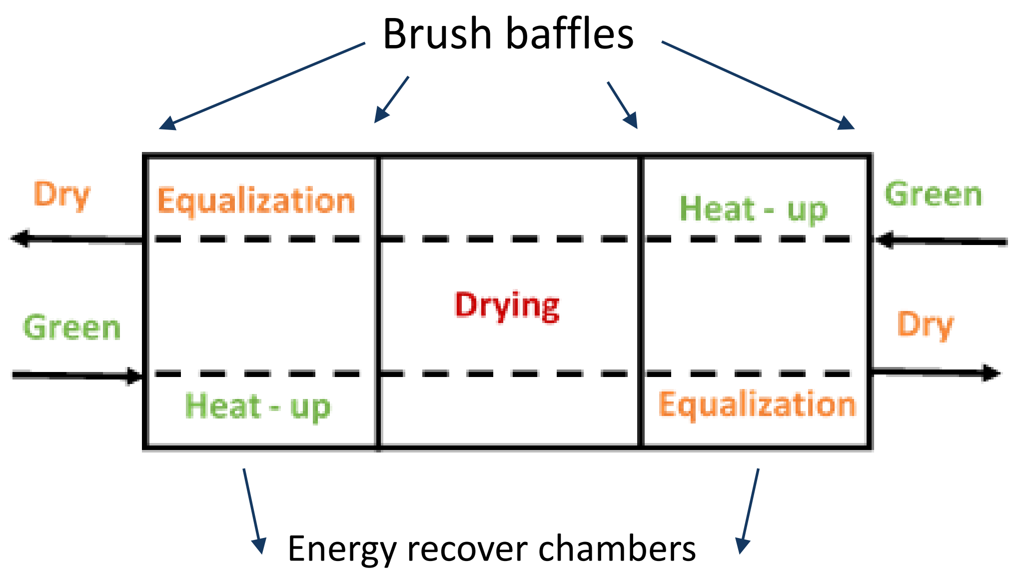
- The progressive-type kilns used in lumber industry are structured to have 1 or 5 chambers in the middle and two energy recover sections at the ends
- Can be loaded in longitudinal or transversal direction
- Lumber incremental movement can be either counterflow or uniflow

Uniflow (transversal loading)

Counterflow (longitudinal loading)

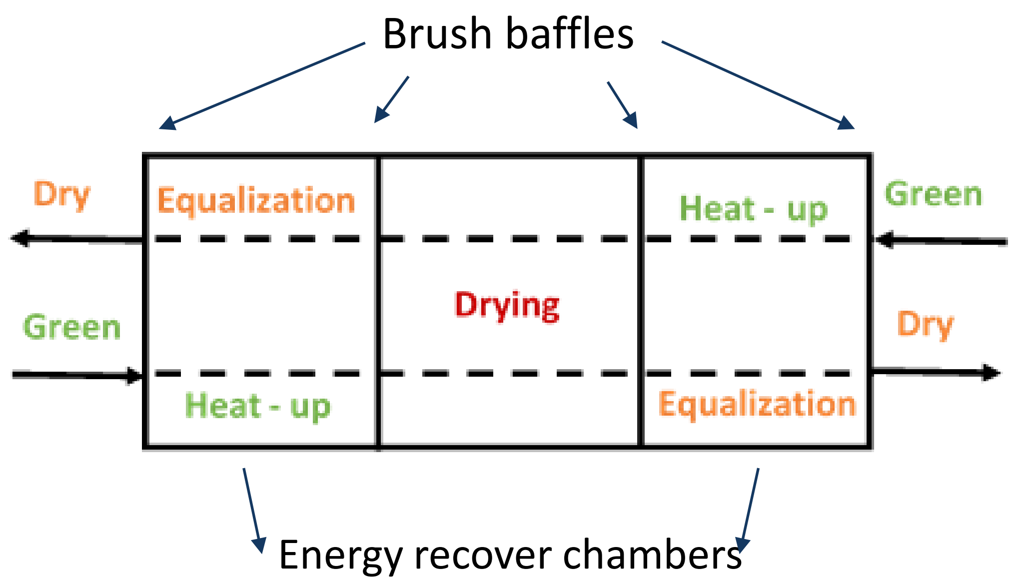
DESIGN

- The majority of the continuous kilns in North America follow the TLC design and are commonly called CDK’s
- Lumber stacks coming into the CDK are pre-heated by the ones exiting the kiln
- Stacks entering the kiln supply a certain amount of moisture to the ones exiting the kiln



DESIGN

- The heated middle chamber is at least 60 foot-long and it represents between 35 and 50% of the total length;
- Common configuration 60/100/60
- The heating system for the main chamber is either indirect (steam or heated oil) or direct fired (hot air supply ducts).



EXAMPLE OF MEASUREMENTS

Summer packages

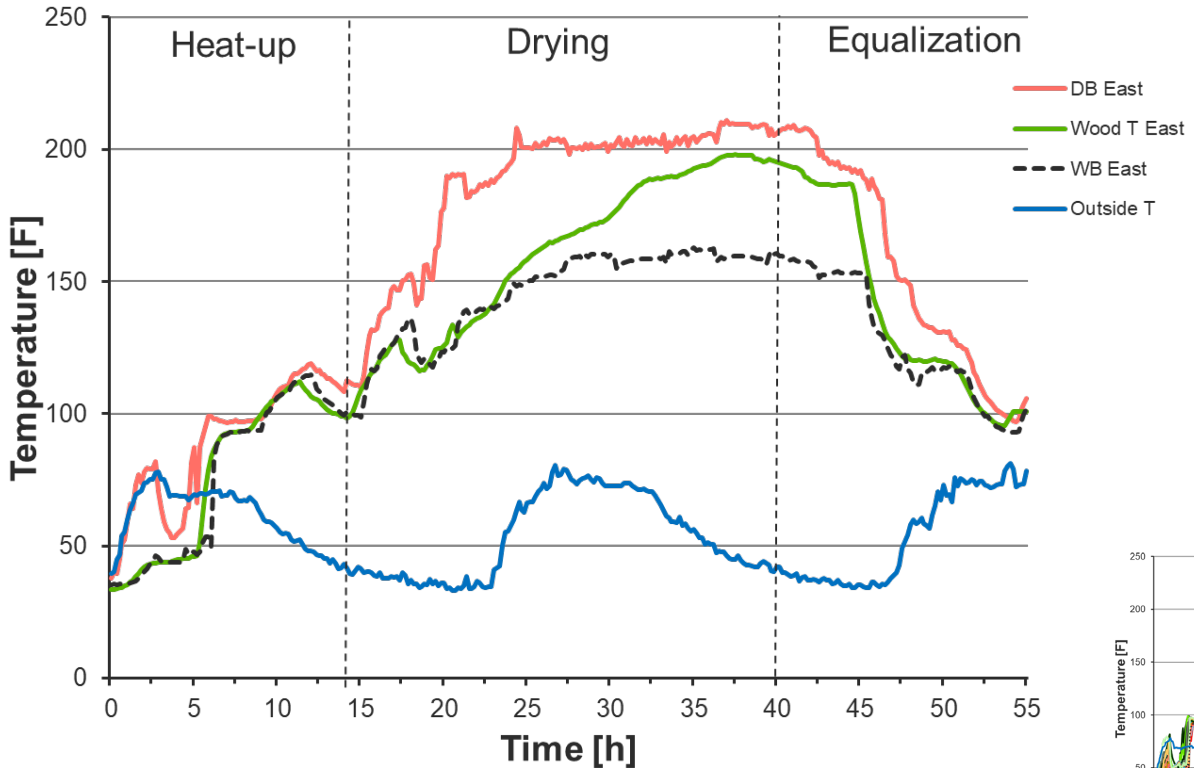
Winter packages

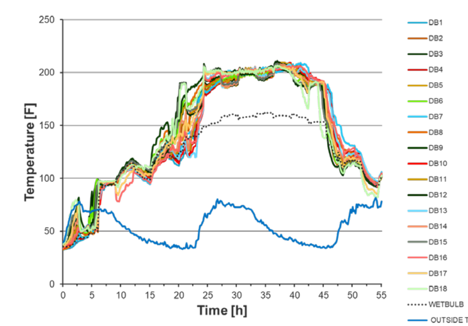
Dry bulb sensors

Wet bulb sensors

Sensors	Total #
Dry-bulbs	18
Wet-bulbs	2
Wood core	20
Outside T	2

MILL RESULTS





SUMMARY OF MEASUREMENTS

- CDK's are primarily used in Canada to dry Spruce-Pine-Fir (SPF), Douglas-fir and to some extent mid, mixed and wet sorts of sub-alpine fir
- Not suitable for precision drying/value added
- Set dry-bulb temperature is between 200 and 235°F
- Wet-bulb depression measurements (not controlled) in 10+ CDK's:
  - Drying chamber – between 40 and 90°F equivalent with 2-4% EMC;
  - Heat-up/Equalization chambers – between 1 and 5°F equivalent with 18-26% EMC
- Air velocity in the main chamber is between 1000 and 1200 fpm

SUMMARY OF MEASUREMENTS

- Depending on the temperature in the main chamber, kiln configuration and species the following residence times in the Drying chamber were recorded

  - SPF mid sort – between 14.7 and 23.8 hrs;
  - SPF wet sort – between 16.7 and 27 hrs;
  - Douglas fir mix – 23.8 hrs;
  - Sub-alpine mid sort – 35.4 hrs (the mid sort is #2 from 4 sorts);
  - Sub-alpine unsorted – 42.8 hrs (followed by re-drying of wets in batch kilns);
  - Sub-alpine wet sort – 50 hrs (followed by re-drying of 10-30% of the lumber in a batch kiln)

STRONG AND WEEK POINTS OF CDK'S

- Energy savings recorded in Georgia US (18-28%) seem to be smaller in Canada (upcoming project)
- Lumber can be transferred to the planer mill as it leaves the kiln (smaller moisture gradient)
- Top layers require weight restrains
- Constant heat demand (no idle periods) makes it ideal for any energy source
- Superior kiln uptime (95%) unless package integrity is an issue (triggering wires may not work well during winter)

STRONG AND WEEK POINTS OF CDK'S

- The water resulting from the CDK's drying process must be collected and disposed
- CDK's don't have static cold spots that can generate under-dried lumber
- Safety concerns:
  - In case of a fire inside a CDK
  - Removing the moisture plates
- Long length of these kilns might interfere with dry-bulb temperature sensor signal (damaged sensors hard to replace)
- Require 24/7 personnel and sometimes, due to the continuous process, extra handling of packages (temporary storage)
- High initial investment costs

DRYING TIME SAVINGS

Typical case 60/100/60 CDK configuration, 205F in main zone, SPF wet, 4.2 ft/hr

Hourly production 9139 fbm/hr at 0.95 kiln uptime

Batch kiln 230 mfbm (100 foot-long) SPF wet, 30 hrs (average drying time)

Hourly production 6516 fbm/hr at 0.85 kiln uptime

Drying time savings 29%

Batch kiln 380 mfbm (160 foot-long) same conditions

Hourly production 10766 fbm/hr at 0.85 kiln uptime

Similar drying times

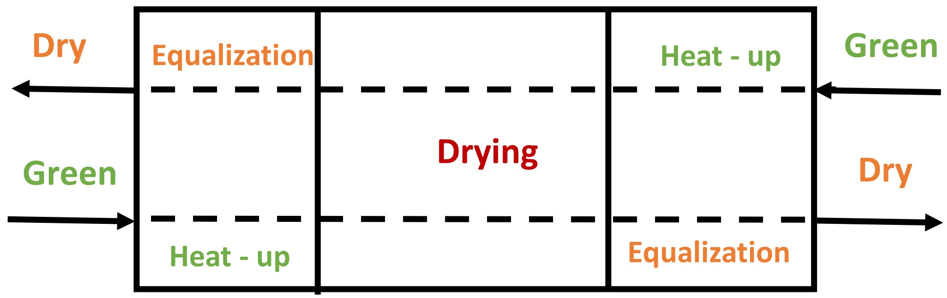
STATISTICAL MODEL

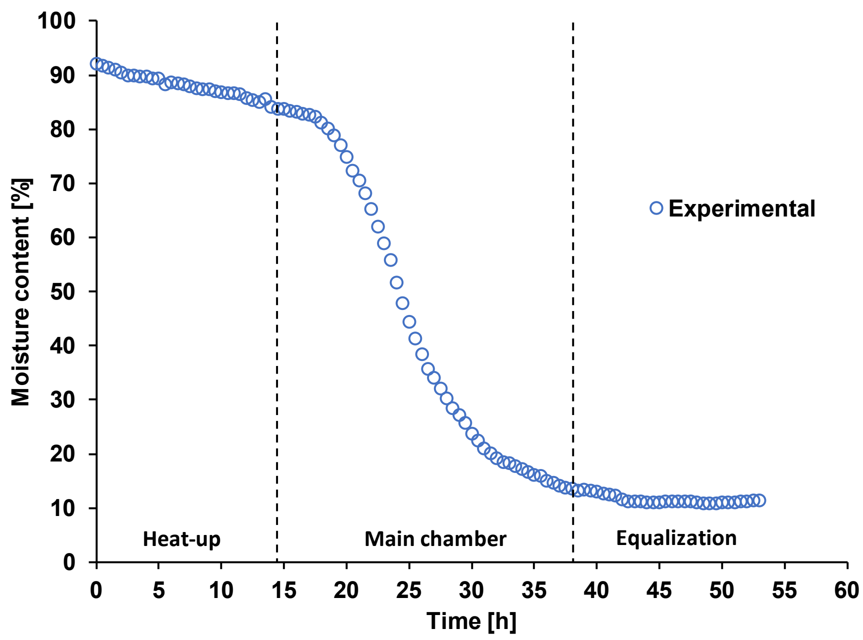
CDK #	CDK Configuration	Push Rate	Set DBT [F]
1	60/100/60	4.1	210
2	74/80/74	5.2	235
3	60/100/60	5.0	220

Input: time & temperature

Output: optimum push rate

STATISTICAL MODEL





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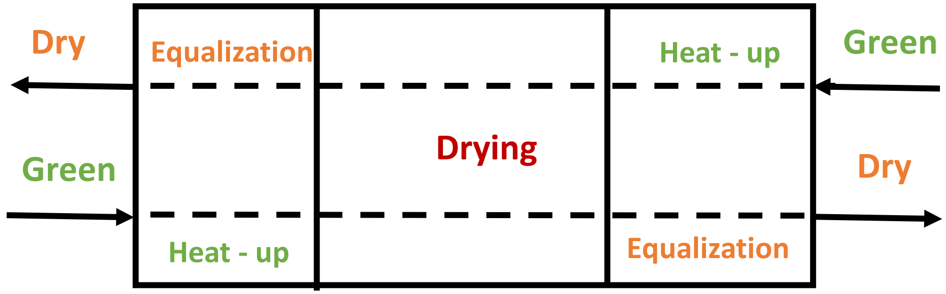

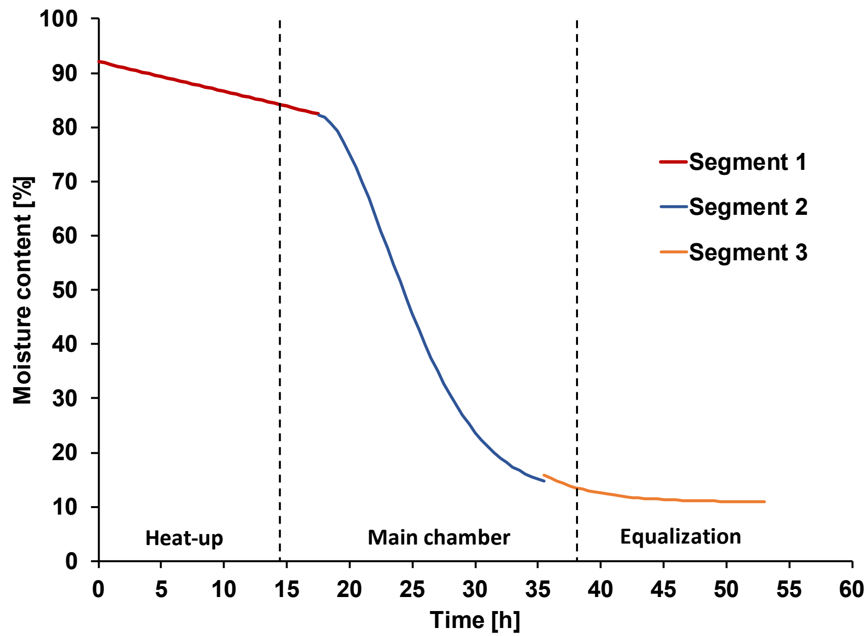

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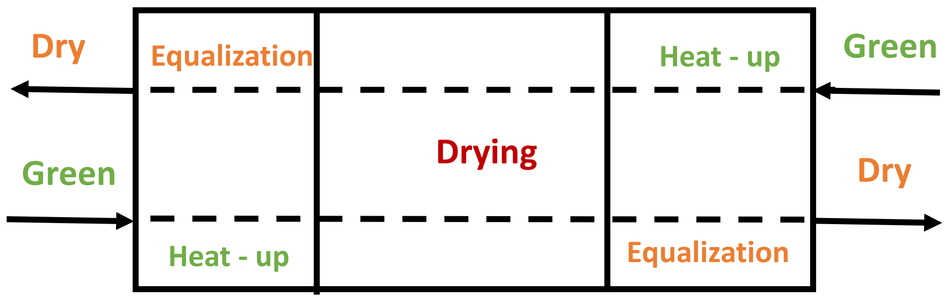
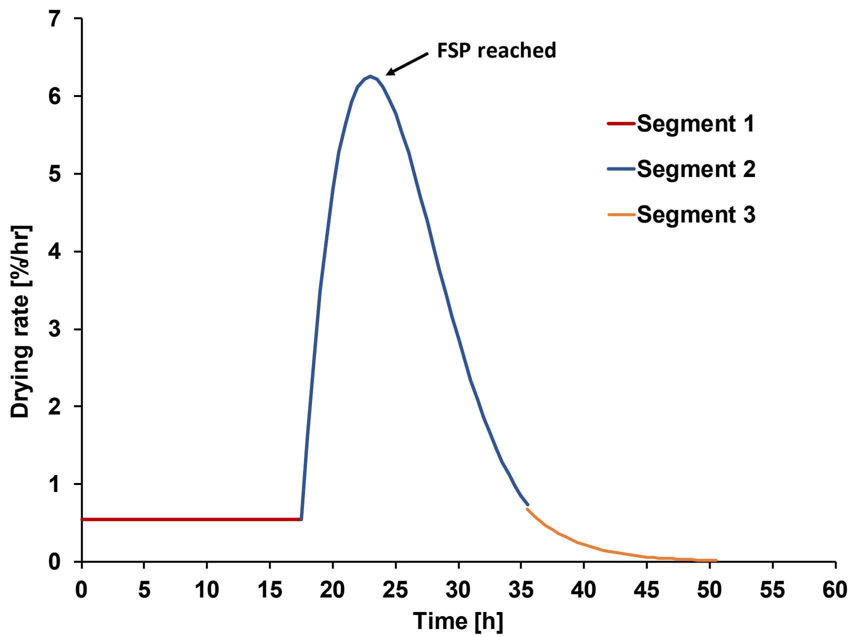


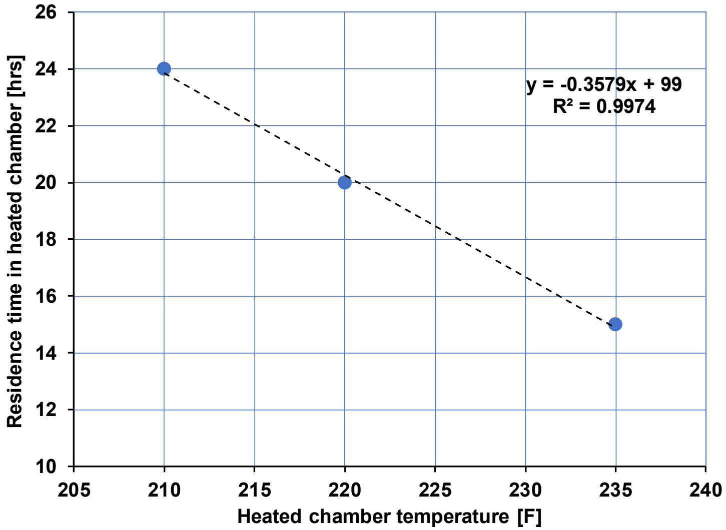


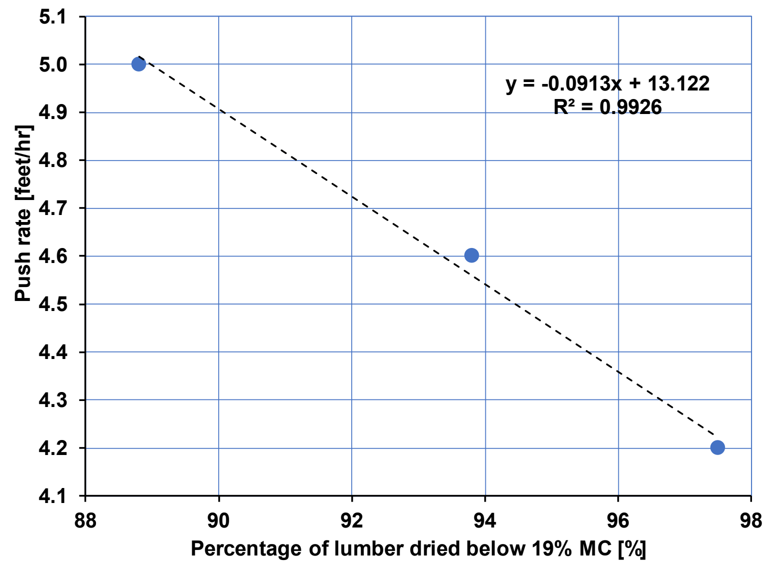
$$\frac{dM}{dt} = -Coefvar$$

$$\frac{dM}{dt} = \alpha_1 \cdot \beta_1 \cdot t^{\beta-1} \cdot (M_{emc} - M)$$

$$\frac{dM}{dt} = \alpha_2 \cdot (M_{emc} - M)$$

TEMPERATURE AND PUSH RATE CORRELATION






FPI ValeurBois
Construction de chemin
Récolte
Transport
Transformation

QUESTIONS?

THANK YOU / GET IN TOUCH

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