Identification of Riding Crops

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Testing Crop Impact Load using a Biomechanical Simulator

Evaluation of the need and potential for a simplified on-track test system

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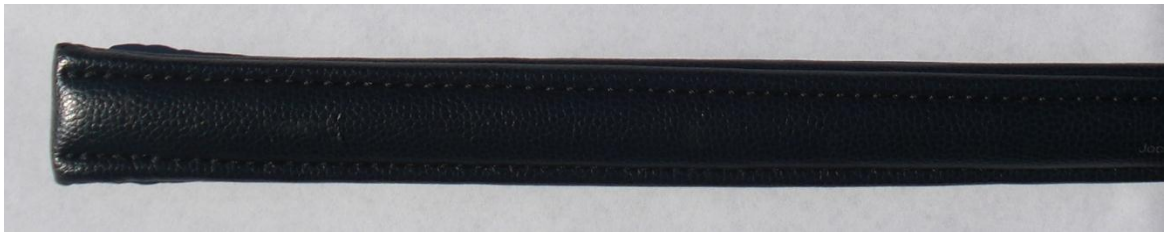
Rule based on dimensions rather than performance



- Padded crop rule was passed that included only size and weight dimensions.
  1. Maximum weight of 6 oz.
  2. Maximum length, including flap, of 28 inches.
  3. Minimum diameter of 0.4 inch.

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Motivation

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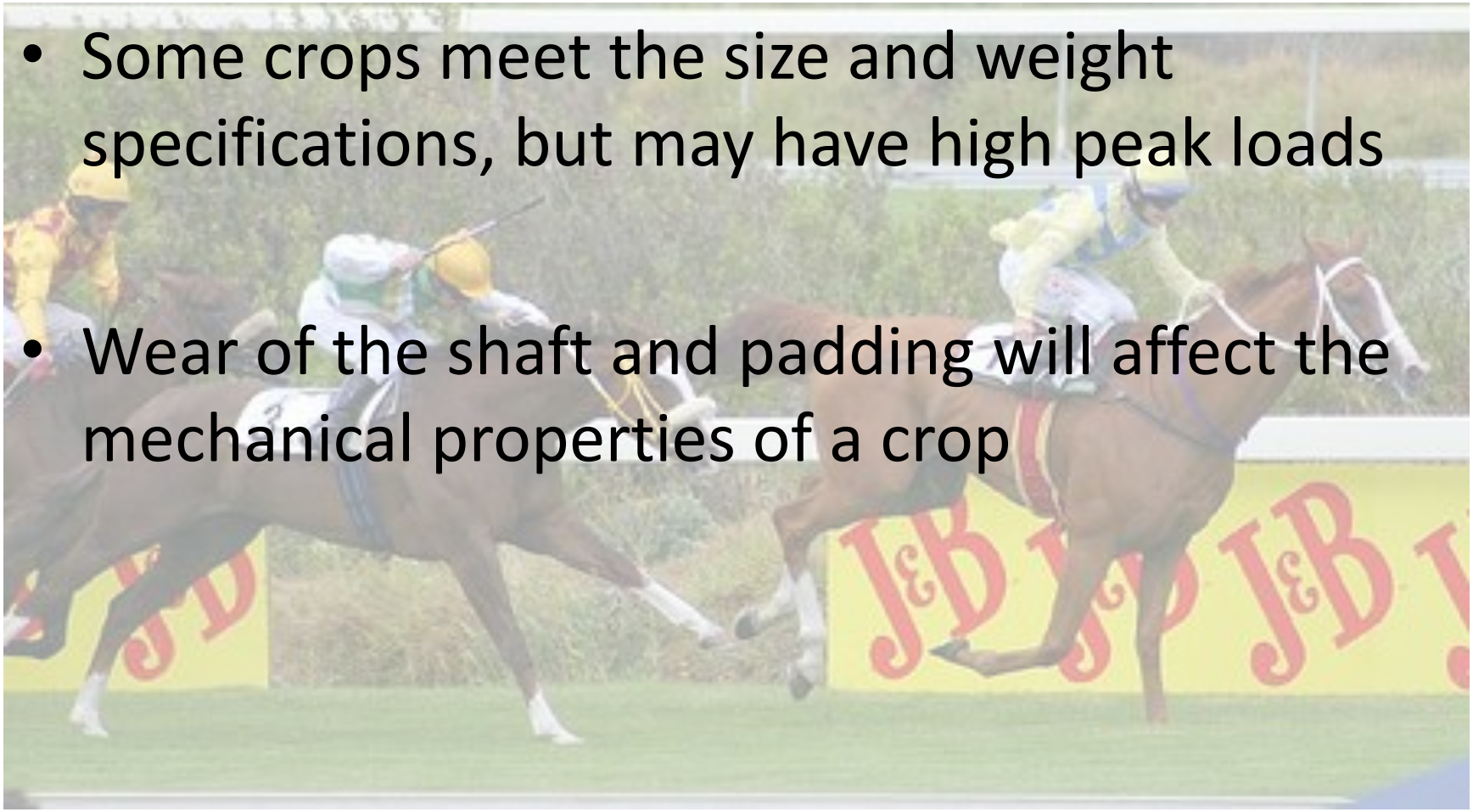
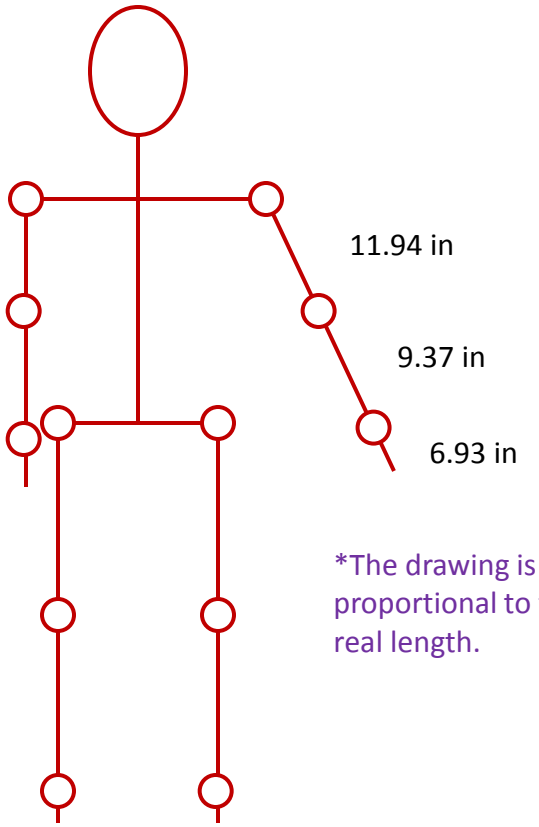


- Some crops meet the size and weight specifications, but may have high peak loads
- Wear of the shaft and padding will affect the mechanical properties of a crop

Anthropometric parameters

- The **proportionality constants** of the arm replicate the size of the average jockey

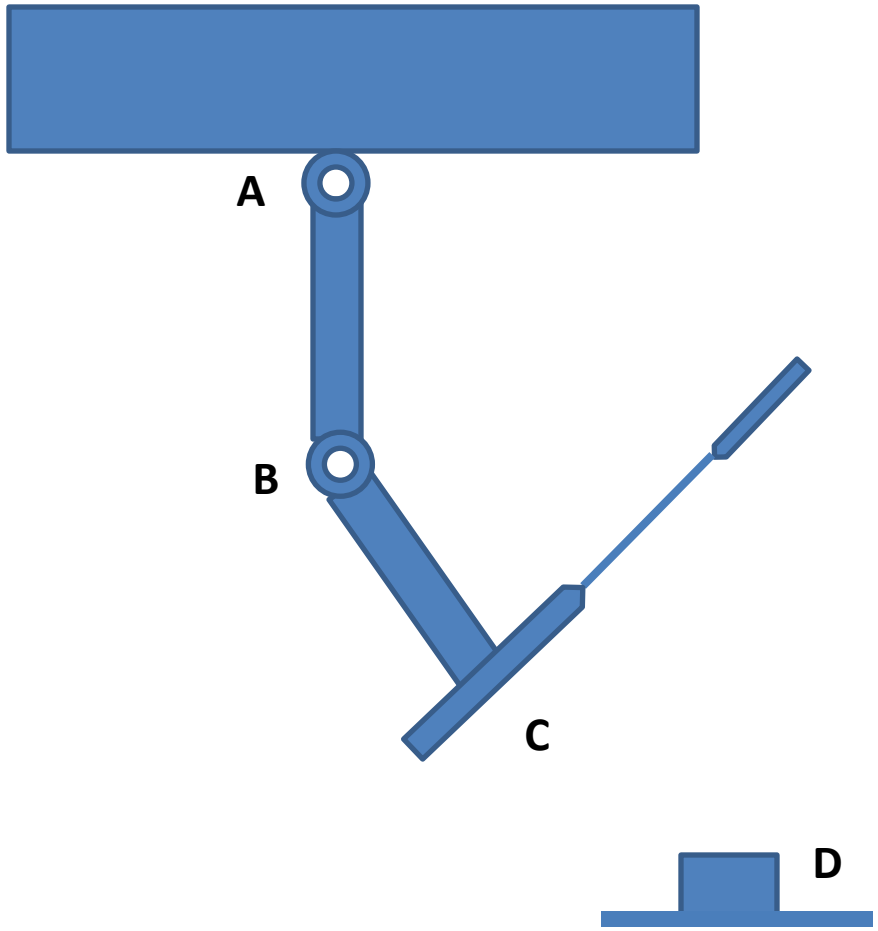


*The drawing is not proportional to the real length.

Segment	Upper Arm	Forearm	Hand
Length (in)	11.94	9.37	6.93
Mass (lb)	3.45	2.00	0.73
M/L ratio (lb/in)	**0.29**	**0.21**	

Simulator design

- Design a 2-link open kinematic chain system to replicate motion of the jockey's arm
- The impact load is recorded using a dynamic load cell at position D
- Speed of the arm is matched to jockey at joints a and b



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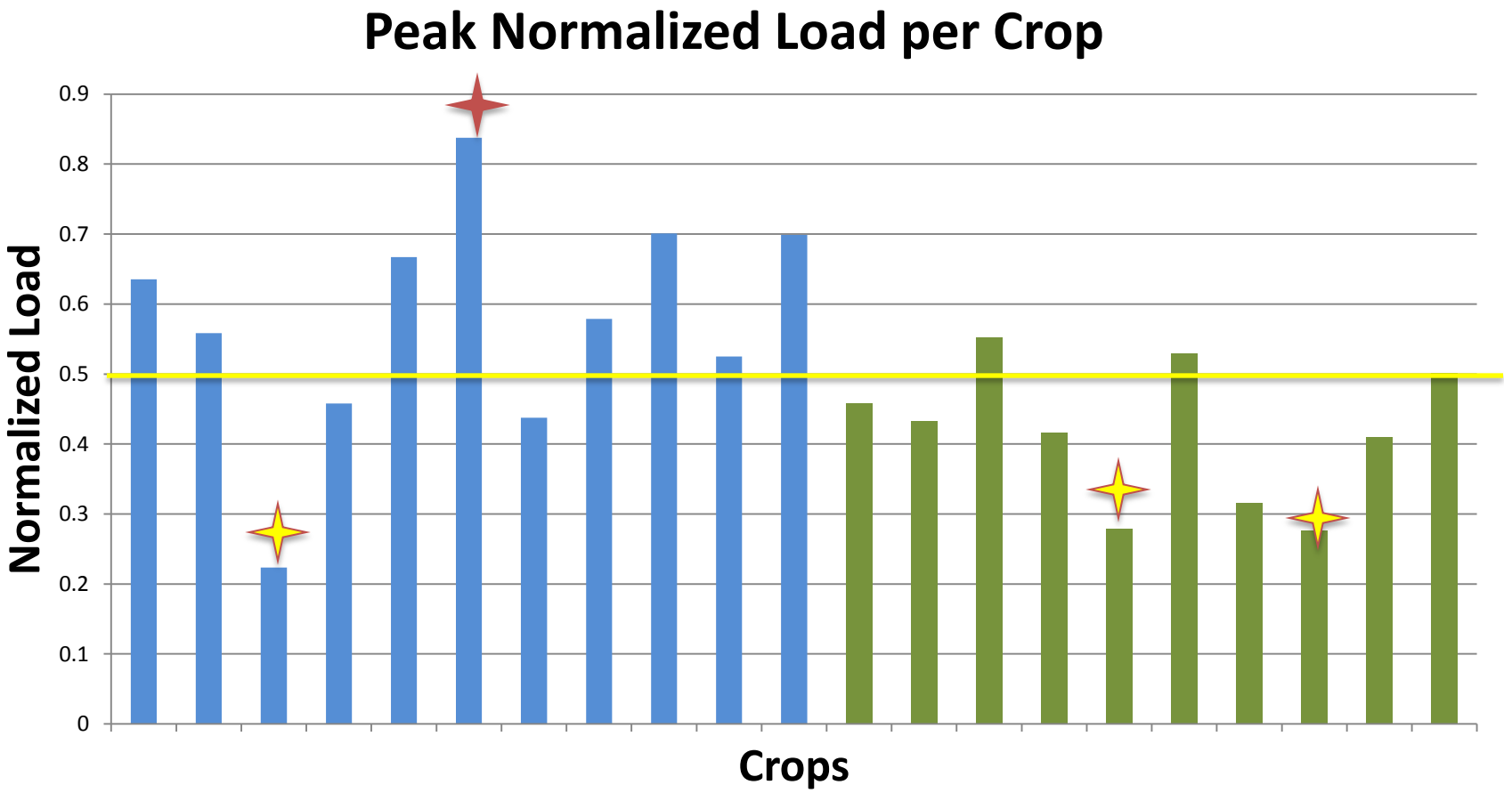

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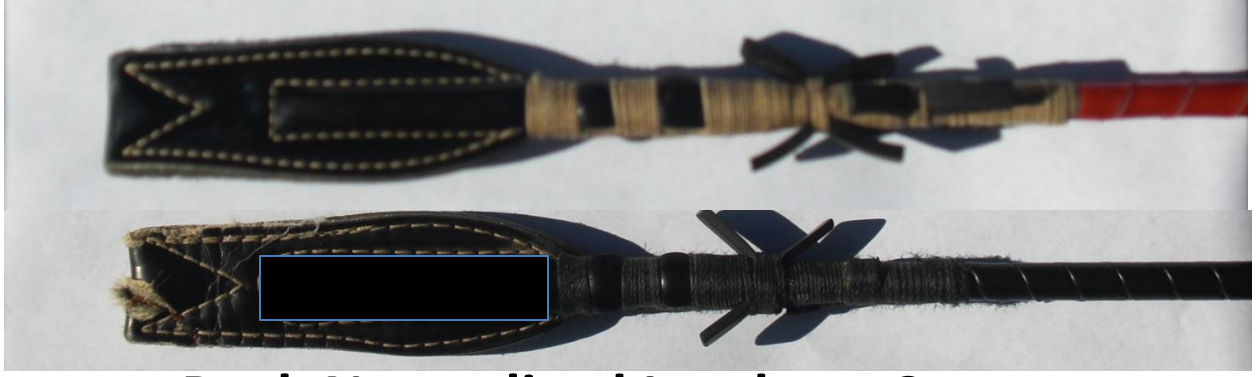

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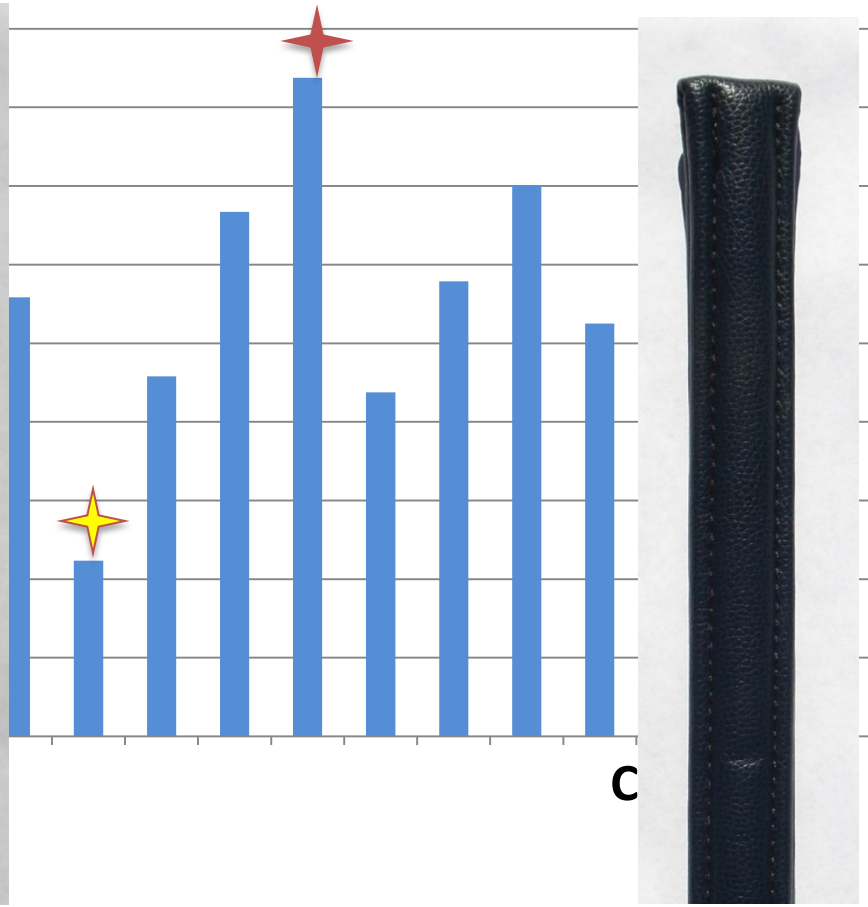
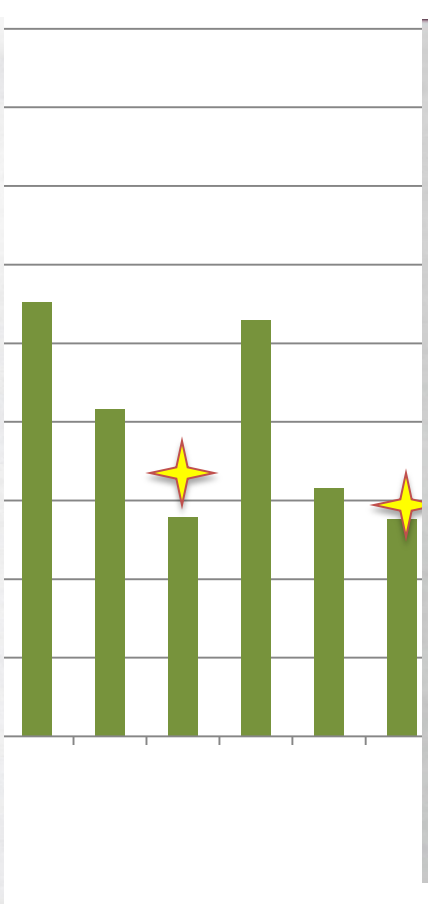
Peak Normalized Load per Crop





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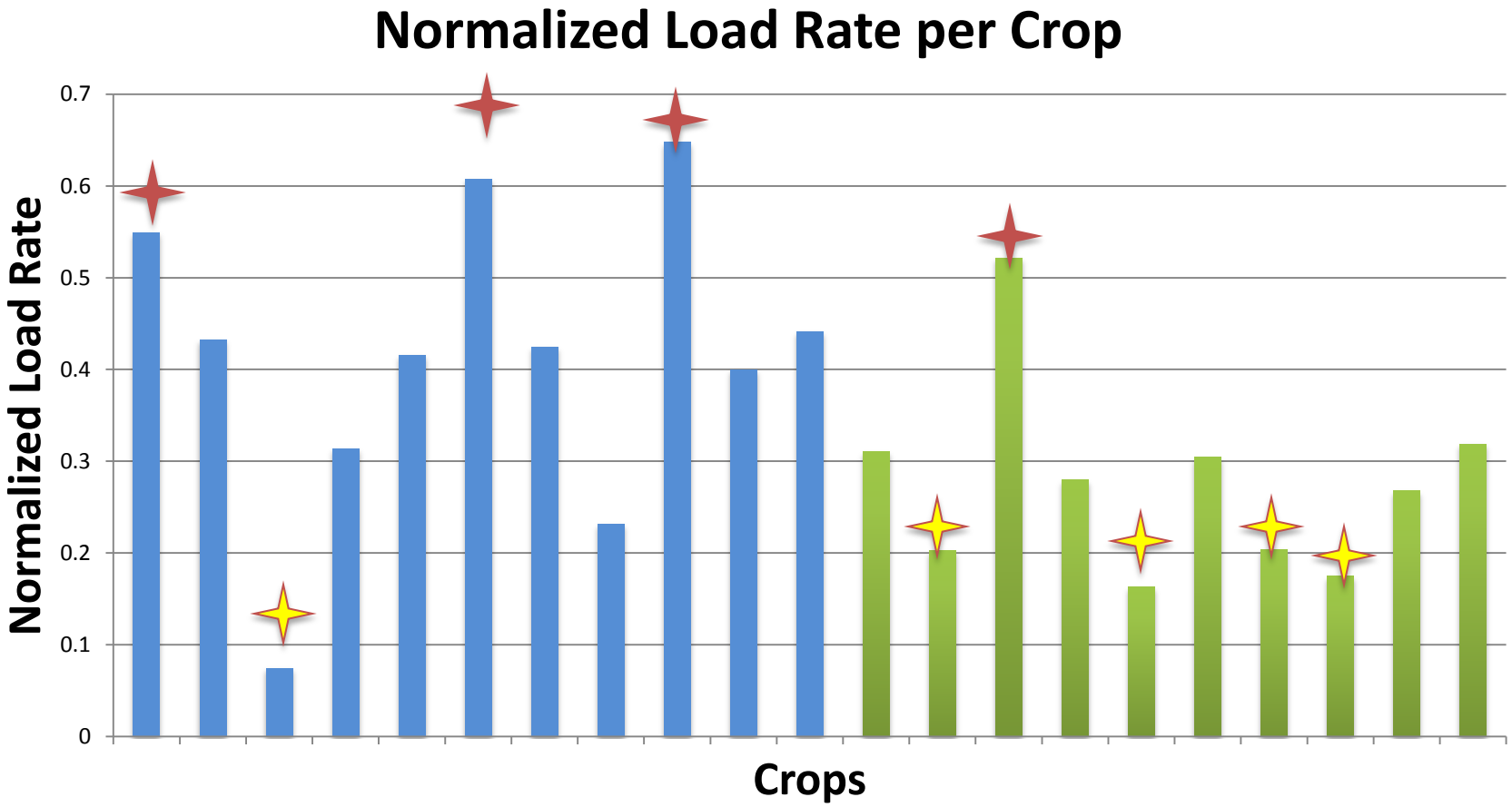

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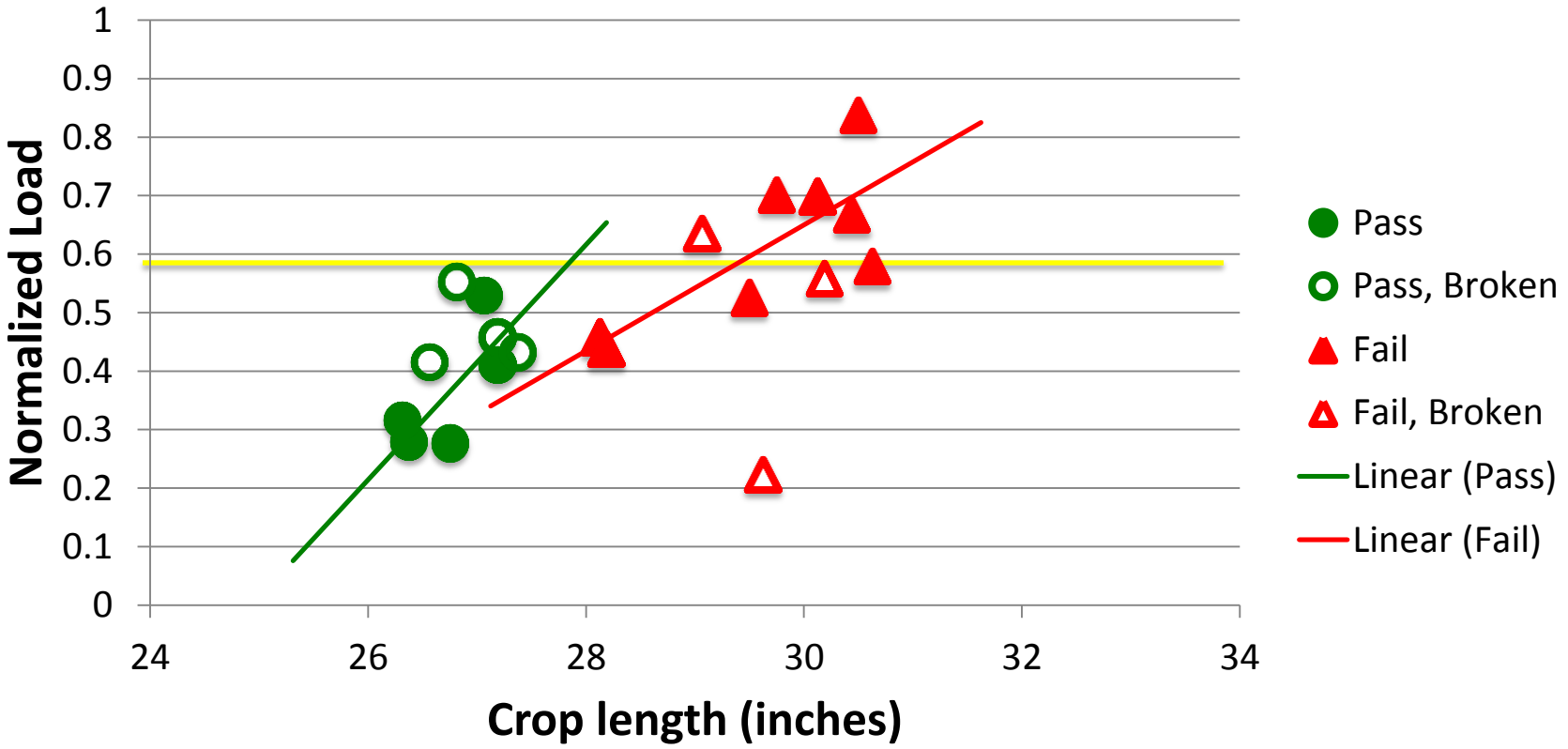
Crop Length is a Primary Factor for the Peak Load



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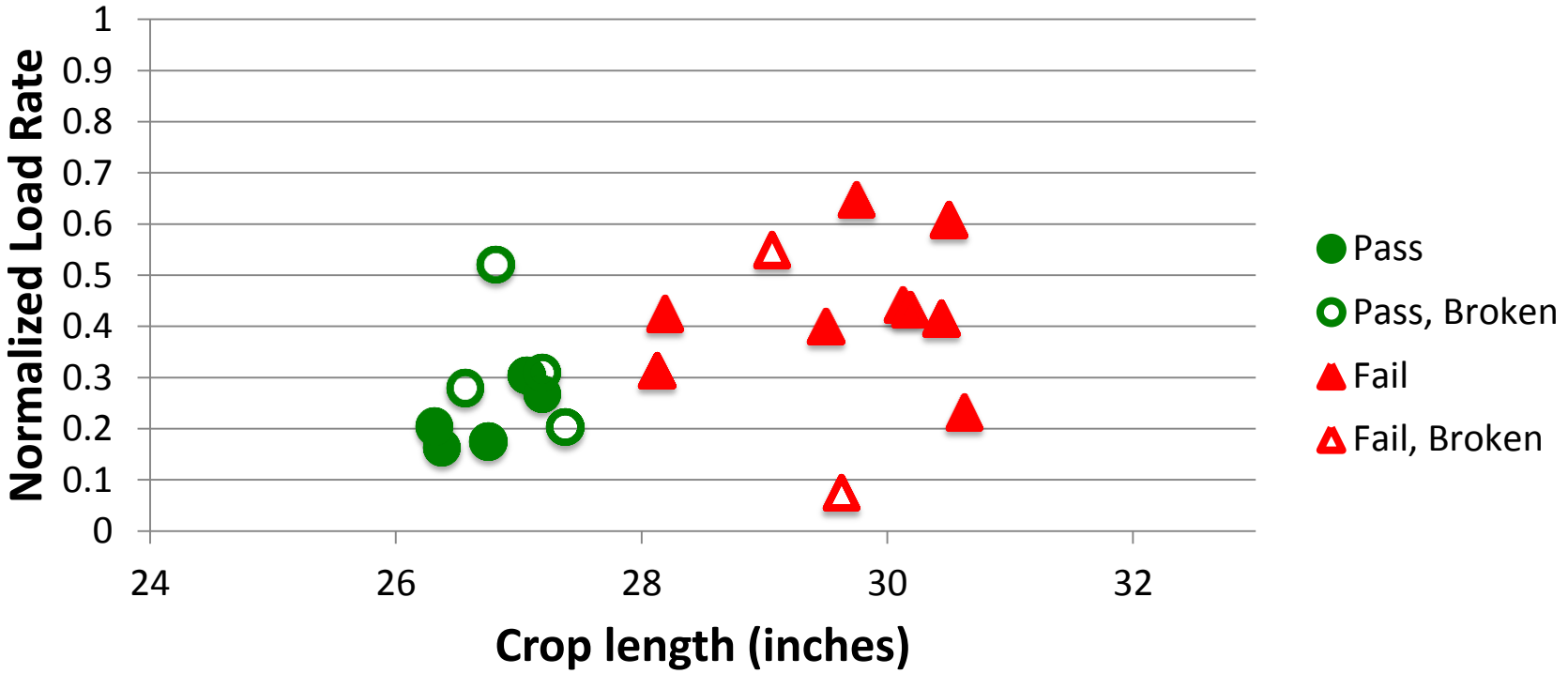
Normalized Load Rate is Influenced by more than the Crop Length



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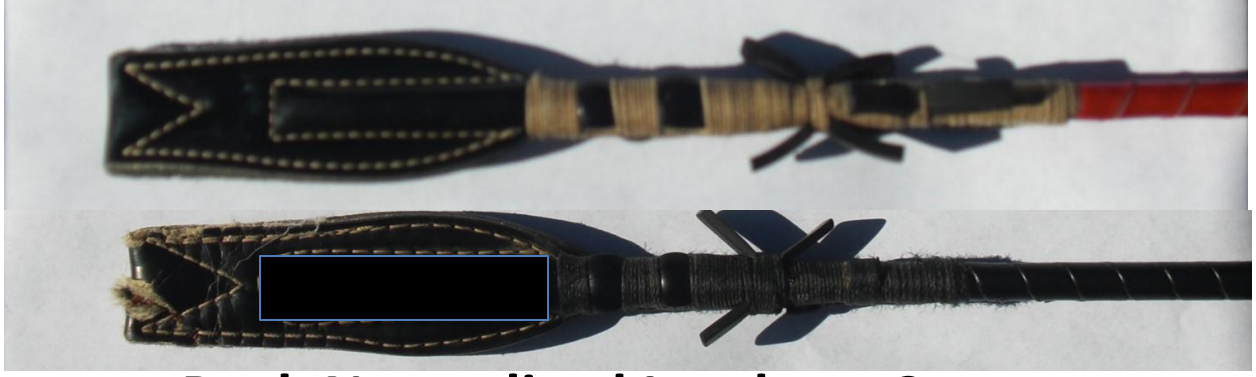

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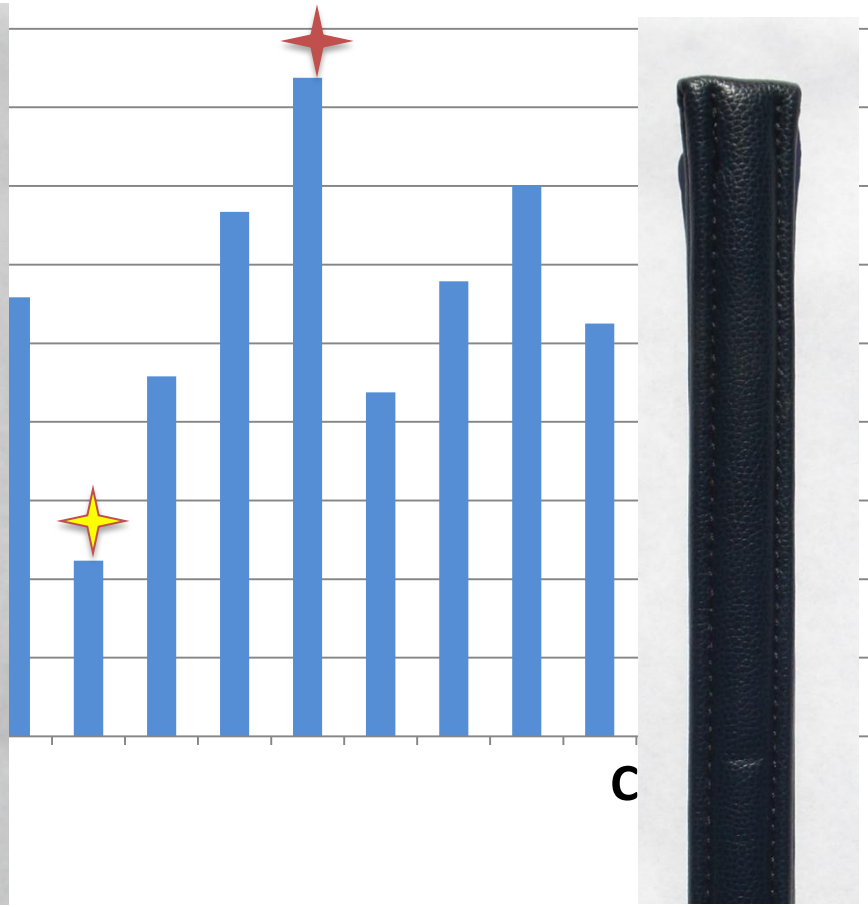
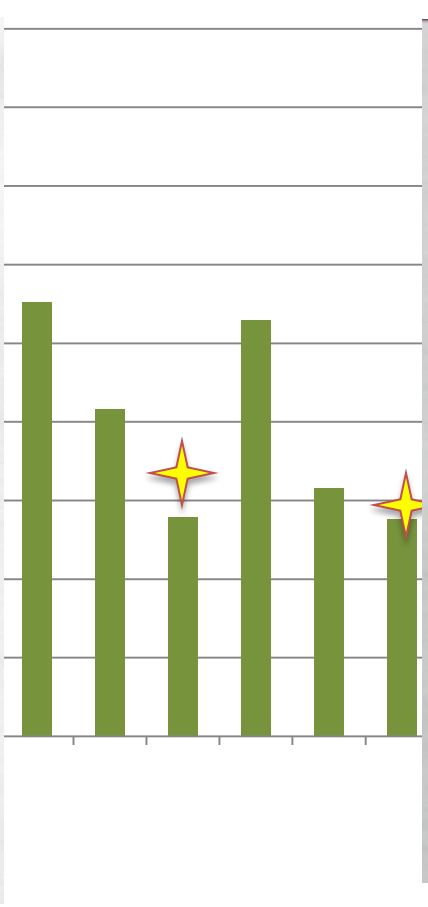
Peak Normalized Load per Crop





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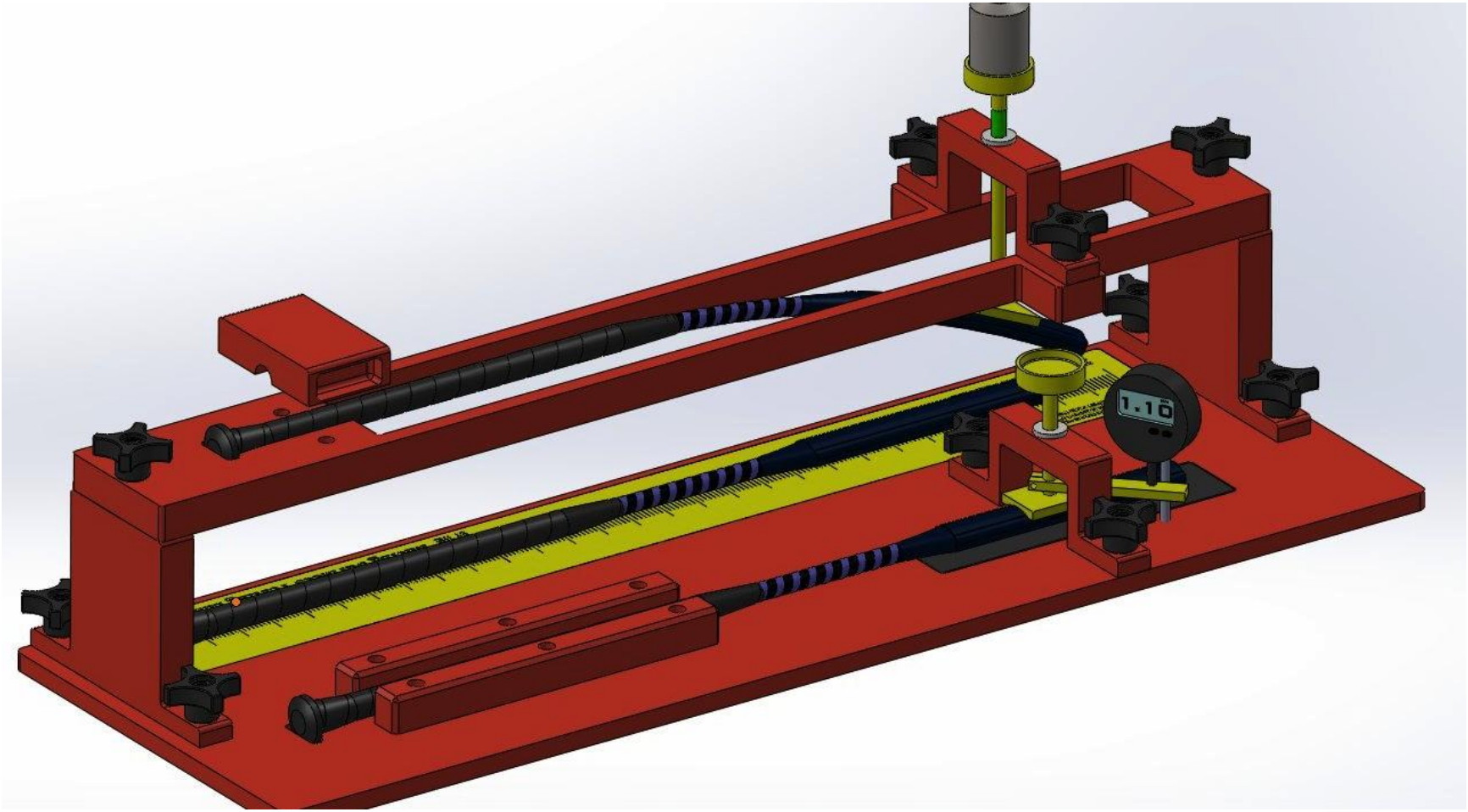
Crop tester:
Shaft Length, Bending and Padding



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Crop tester:
Shaft Length, Bending and Padding

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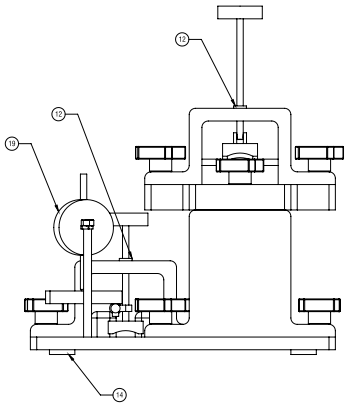

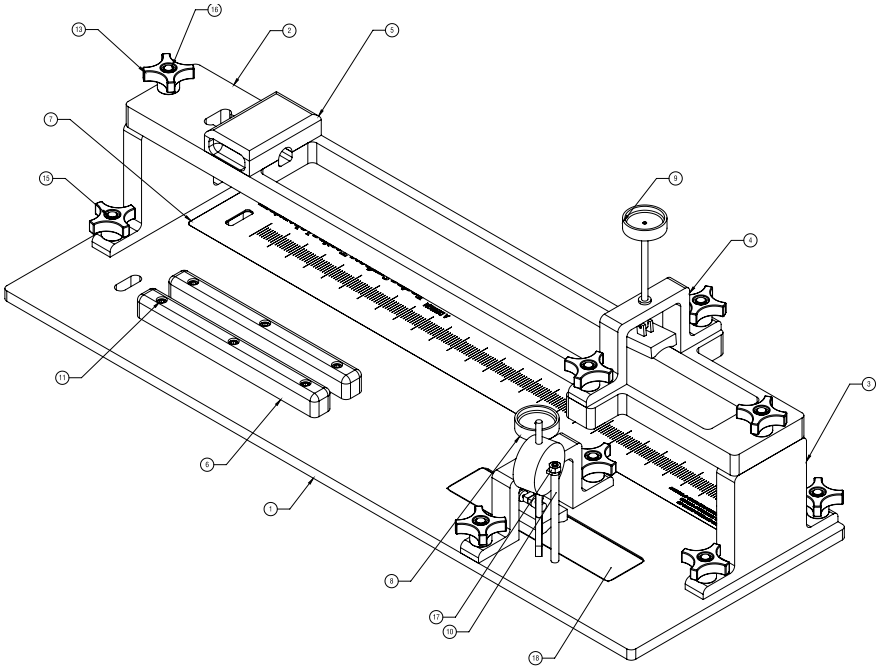

ITEM	QTY	PART / DWG NO	DESCRIPTION	MATERIAL
19	1	N/A	FOWLER ELECTRONIC INDICATOR	VARIOUS
18	1	9694K79 MMC	2.0x5.0x0.25 NEOPRENE PAD	NEOPRENE
17	1	92676A029 MMC	1/4-20 HEX NUT	BRASS
16	2	92386A632 MMC	2.5L SELF-LOCKING STUD	SS
15	8	92386A632 MMC	2.0L SELF-LOCKING STUD	SS
14	4	8638T21 MMC	BUMPER	POLYURETHANE (11671)
13	10	5993K310 MMC	BLACK PHENOLIC KNOB	VARIOUS
12	2	270ETT4 MMC	FLANGED SLEEVE BEARING	PTFE (general)
11	6	93480A542 MMC	1/4-20 1.0L SOCKET HEAD CAP SCREW	BRASS
10	1	RBC1221-0101	DIAL INDICATOR ROD	6061 Alloy
9	1	RCB1221-0097	LOAD ROD, DEFLECTION	VARIOUS
8	1	RBC1221-0087	LOAD ROD, DUROMETER	VARIOUS
7	1	RBC1221-0071	GAUGE PLATE	PE High Density
6	2	RBC1221-0061	GRIP BAR	6061 Alloy
5	1	RBC1221-0057	GRIP CLAMP	6061 Alloy
4	2	RBC1221-0041	LOAD ROD BRACKET	6061 Alloy
3	2	RBC1221-0031	BEND FIXTURE STAND	6061 Alloy
2	1	RBC1221-0021	BEND FIXTURE PLATE	6061 Alloy
1	1	RBC1221-0011	BASE PLATE	6061 Alloy

PARTS LIST

ALL DIMENSIONS ARE INCHES UNLESS OTHERWISE SPECIFIED.
INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5-2009

TITLE: CROP PRO
DRAWN: S.GRAY
DATE: 15-AUG-2012
DRAWN FOR: RACING SURFACE TESTING LAB
DRAWING NO.: RBC1221-4007
CHECKED: R.BEAUMONT
DATE: 05-SEPT-2012
MATERIAL: VARIOUS

STANDARD TOLERANCES UNLESS OTHERWISE SPECIFIED
FRAC | ANG | XX | XXX | XXXX

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Summary

- Crop length is a primary factor.
- Crops should also be tested by performance - Dimensions are not enough.
- Crop use is critical – human aspect

Acknowledgements

- Funding by The Jockey Club Thoroughbred Safety Committee, NTRA, TOBA and the Jockey's Guild

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Acknowledgements

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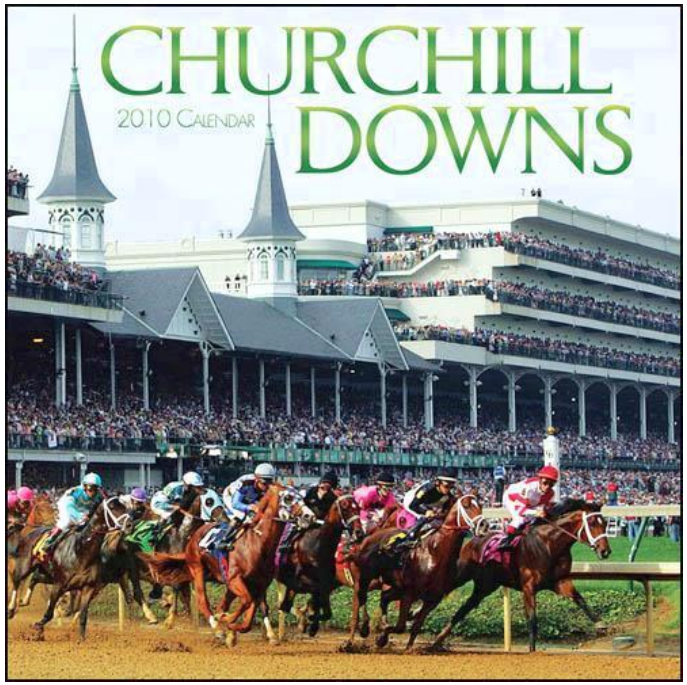
OAK TREE

OAK TREE RACING ASSOCIATION

CHURCHILL DOWNS



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NTRA

California Authority of Racing Fairs CARF

NYRA