CAPTG
Calgary, AB, Canada
September 12, 2010

Transport Canada/Boeing Gravel Runway Penetrometer Seminar

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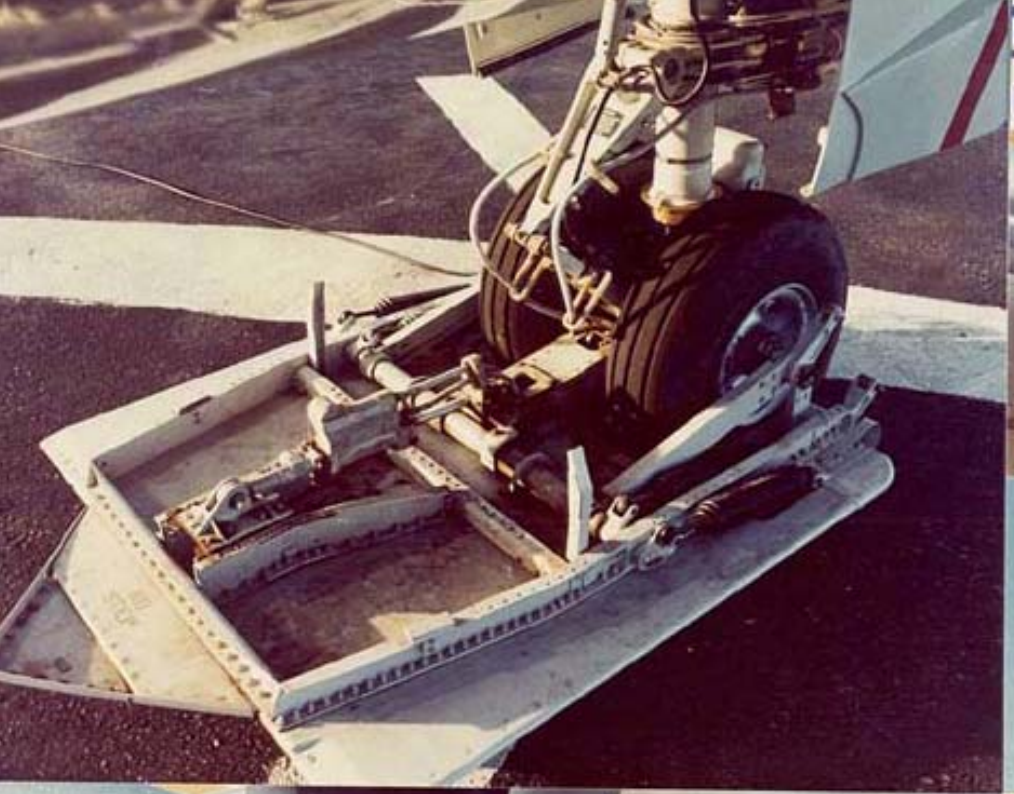



LASKA

High Load Penetrometer Document

D6-24555 original date: 12/17/69

INTRODUCTION

Paragraph 3:

.....Its advantages are: accuracy, convenience, versatility, speed of use~~, and it can be operated by untrained personnel~~.

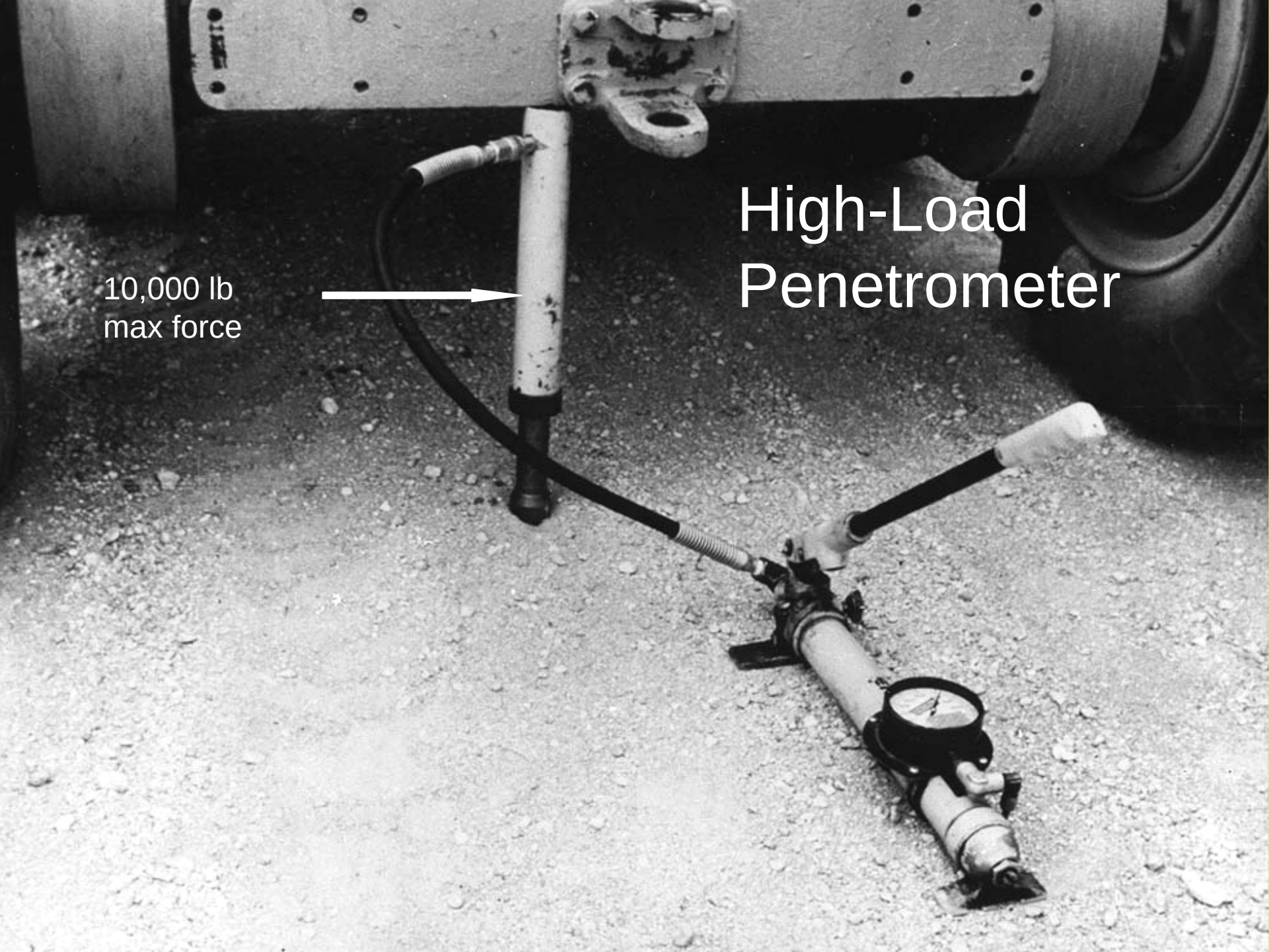
The struck out wording has been removed

Penetrometer Seminar Agenda

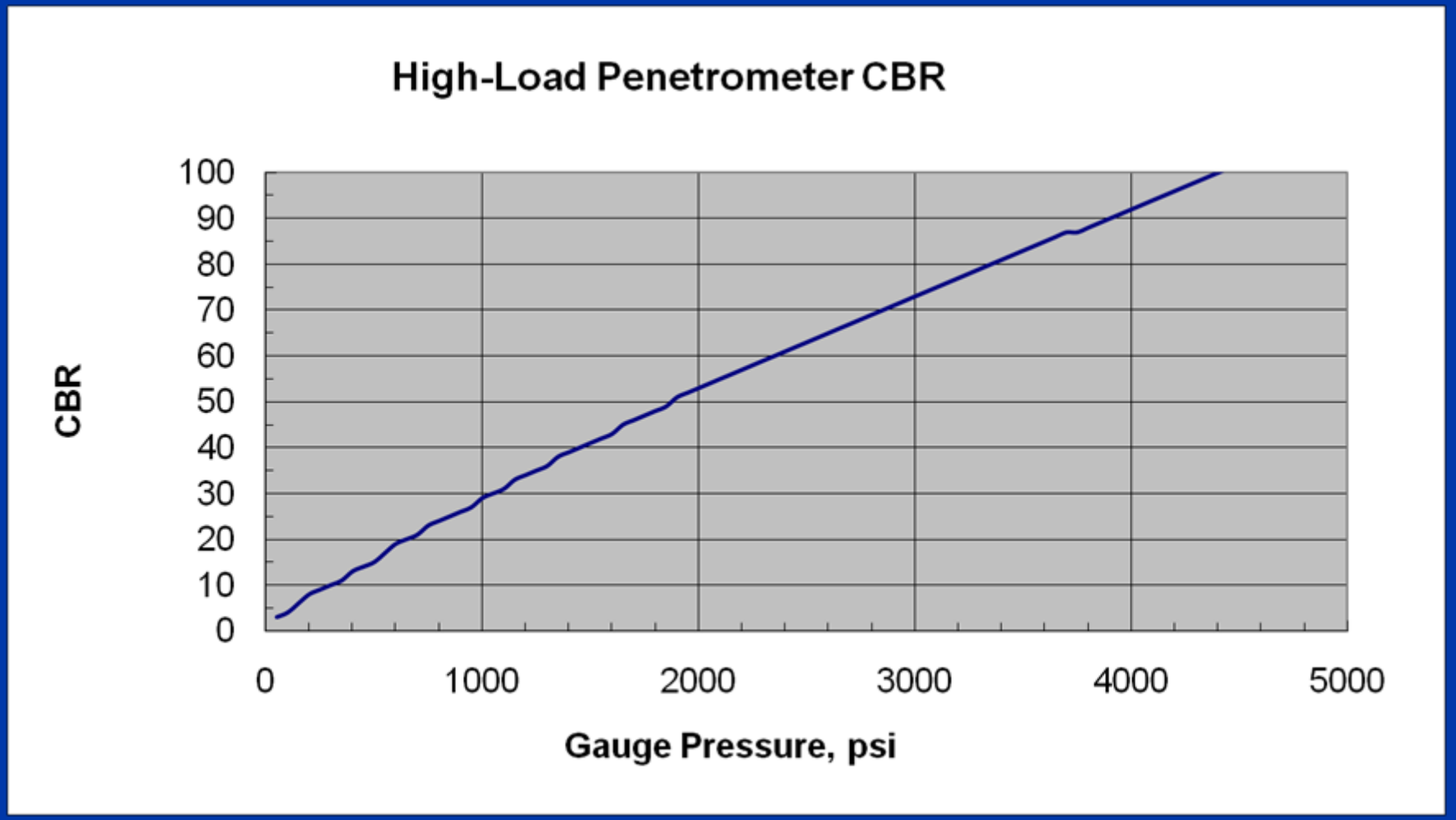
- **Location - Yellowknife**
- **Date - October 14, 2010**
- **Class agenda**
  - 1-2 hours indoors classroom
  - 6-8 hours outdoors hands on experience
- **Video recorded for future users**
- **Certificate of participation**

Acknowlegements

- **Kate Fletcher - Transport Canada**
- **Ken DeBord & Orrie Shepson – Boeing**
- **Steve Nourse - NATA**
- **Ben Webber - Yellowknife**
- **Travis Drover – Yellowknife**
- **Lawrence Canning – Yellowknife**
- **Lauren Trudel**
- **Kevin McLeod**
- **Mark Ritchie - Yukon**
- **Ron Erlandson**


High-Load
Penetrometer
10,000 lb
max force

Gauge Pressure vs. CBR



Placard

PSI	CBR	PSI	CBR	PSI	CBR
50	2	1250	34	2450	61
100	3	1300	35	2500	62
150	4	1350	36	2550	63
200	6	1400	38	2600	64
250	8	1450	39	2650	65
300	9	1500	40	2700	66
400	11	1600	42	2800	68
800	23	2000	52	3200	76
2100	54	3300	78	4500	101

Example Gravel Runway

Location: Rankin Outlet

Elevation: 450’

Apron:

Size:

Condition: good

Runway: 13/31

Length: 5000’

Width: 160’ to lights

Shoulders: 75’

Lighting: edge, threshold

Roughness: short wave

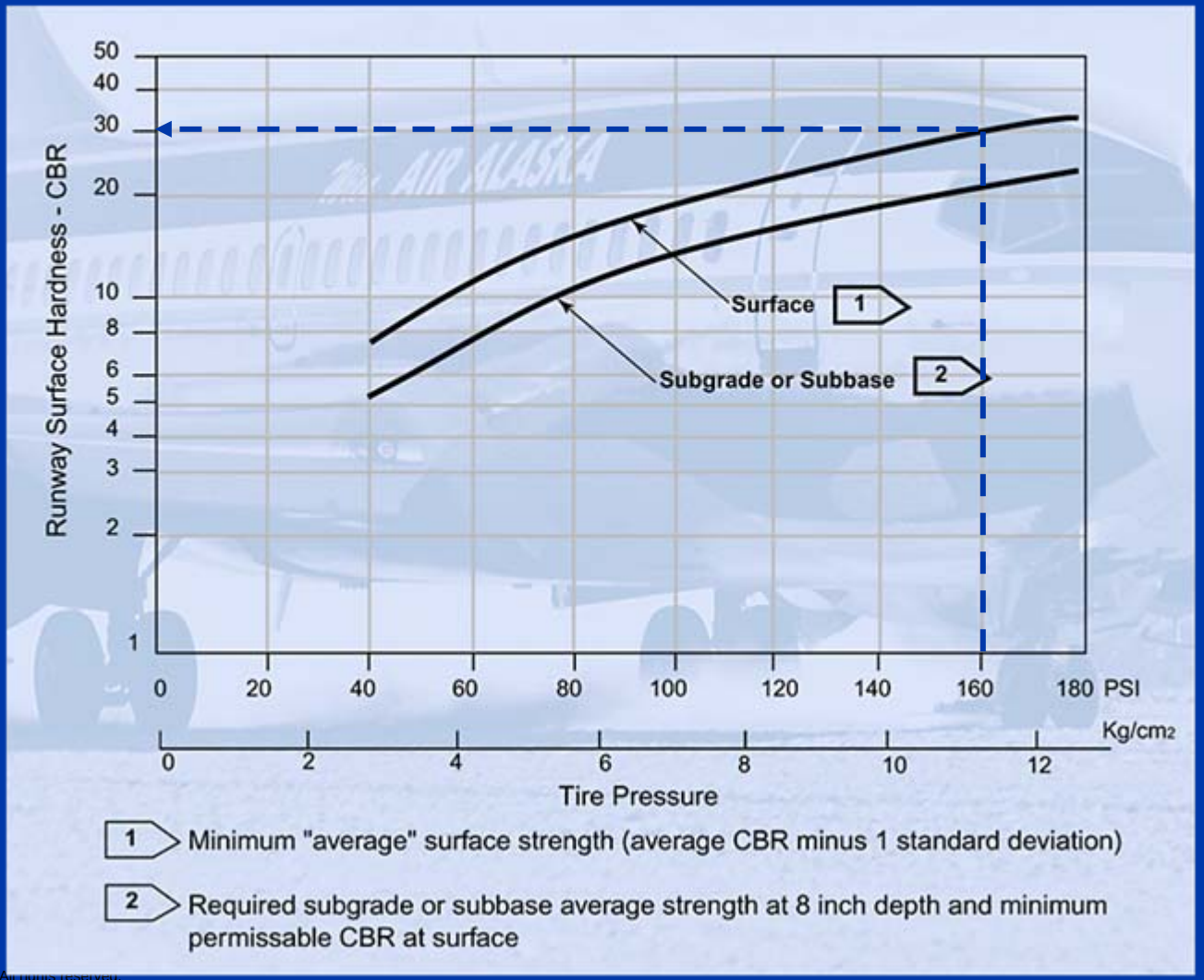
Drainage: good crown

Material: silty sand some clay

Test results

PENETROMETER DATA			
DEPTH:	4"	7"	10"
#	psi	psi	psi
1	1050	1900	2700
2	1400	2500+	
3	1650	2500+	
4	1000	1400	slid off rock
5	1500	2100	
6	1050	1100	
7	1400	2100	
8	400	800	1150
30	1900	1850	

Unpaved Runway Hardness Requirements



Calculation

- **Surface:**
  - Average = 1600 psi
  - Std Dev = 250
  - Avg less std dev = 1350 psi
- **CBR = 36**
- **Tire pressure = 160 psi**
- **Required CBR = 30**

- **Base:**
  - Average = 1600 psi
  - Std Dev = 350
  - Avg less std dev = 1250 psi
- **CBR = 34**
- **Tire pressure = 160 psi**
- **Required CBR = 20**

Flight Manual Requirements

1. Construction Specs
2. Surface Requirements
3. Surface Maintenance
4. Airplane Operation

Flight Manual Requirements

1. Runway Construction

- Uniform covering of gravel
  - No areas of deep, loose gravel deficient in fines
  - No surface stones greater than 2.5 inches (6 cm) in diameter
- Well compacted
- Surface material must be at least 6 inches thick

Flight Manual Requirements

2. Surface Requirements

- California Bearing Ratio of 30 (35 for 727) as measured with the Boeing High-load Penetrometer
- The subbase strength at a depth of 8 inches below the runway surface shall demonstrate a CBR of 20 (25 for 727)
- Field surface condition and bearing strength test examination for each gravel runway

Flight Manual Requirements

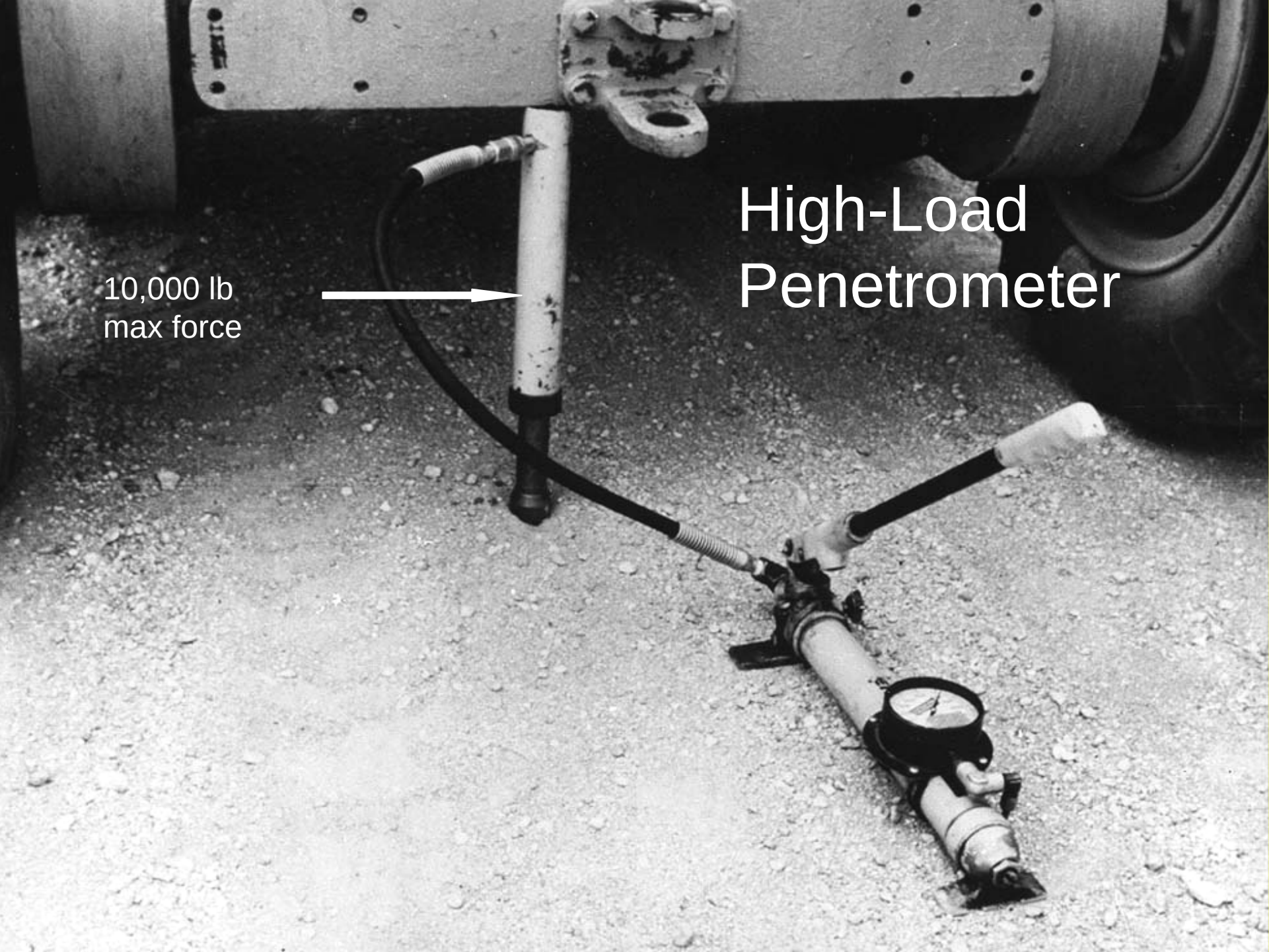
3. Runway Maintenance

- Kept graded smooth
- Free from ruts and standing water
- Facilitate surface water drainage (good crown)
- No areas of deep loose gravel deficient in fines

Flight Manual Requirements

4. Airplane Operations

- Takeoff and landing length penalties apply
- No reverse thrust (737)
- Pilot must ensure that vortex dissipator outlets are clear (737)
- Avoid abrupt turns at low speeds


High-Load
Penetrometer
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Penetrometer Maintenance

- Wipe off shaft after every use
- Use provided ejector
- Calibrate periodically
- Hydraulic fluid levels

Certificate Of Participation

Transport Canada and the Boeing Company would like to acknowledge that

_____*your name*_____

Has participated in

Gravel Runway Penetrometer Training

October 14, 2010 at Yellowknife, NWT, Canada

Authorized Signature

_____

References

- **D6-45222**
  737 Gravel Runway Requirements

- **D6-24555**
  High Load Penetrometer Soil Strength Tester