



DOCUMENT TITLE PAGE

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Program Project No.	# 0502-81-013	(1) Master Info Center 50120
Pilot Inst. Center No.	Title FRICTIONAL LOSSES IN A PHASE 3 4T-390 (40521138) CASE/CUMMINS ENGINE	(2) Info Center
Test Project No.		(3) Info Center
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SUMMARY

PURPOSE: To determine frictional losses on a turbocharged Phase 3, Family I 4T-390 (40521138) engine.

SUMMARY: Test work was done in test cell 110, which is equipped with a motoring dynamometer. The engine was equipped with an 88mm water pump pulley and a Bosch VE4/12 fuel pump and has a compression ratio of 17.2.

Results showed:

1. Friction mean effective pressure (FMEP) with disconnected turbocharger and 160°F oil pan temperature is very close to predicted FMEP by Millington and Hartless (SAE paper 680590).
2. A formula was found to describe FMEP as a function of oil pan temperature and engine speed for both configurations, disconnected turbocharger and running turbocharger.

$$FMEP = a + (b-c.T) . RPM + d . RPM^2$$

FMEP (bar)
T (°C)
RPM (r/min.)

- a = 1.632
- b = 4.66 E-4
- c = 4.24 E-6
- d = 1.128 E-7 (without turbo)
- d = 1.528 E-7 (with turbo)

Attachments 1 and 2 show measured friction at different engine speeds and oil pan temperatures. The curves fitted through these measurement points represent above mentioned formula. The disconnected turbocharger shows only a change of constant d, because pumping losses are reduced which are a square function of engine speed.

ACTION: Keep data in file for upcoming friction tests.

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Senior Engineer -
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Mark Thommen

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Attachments

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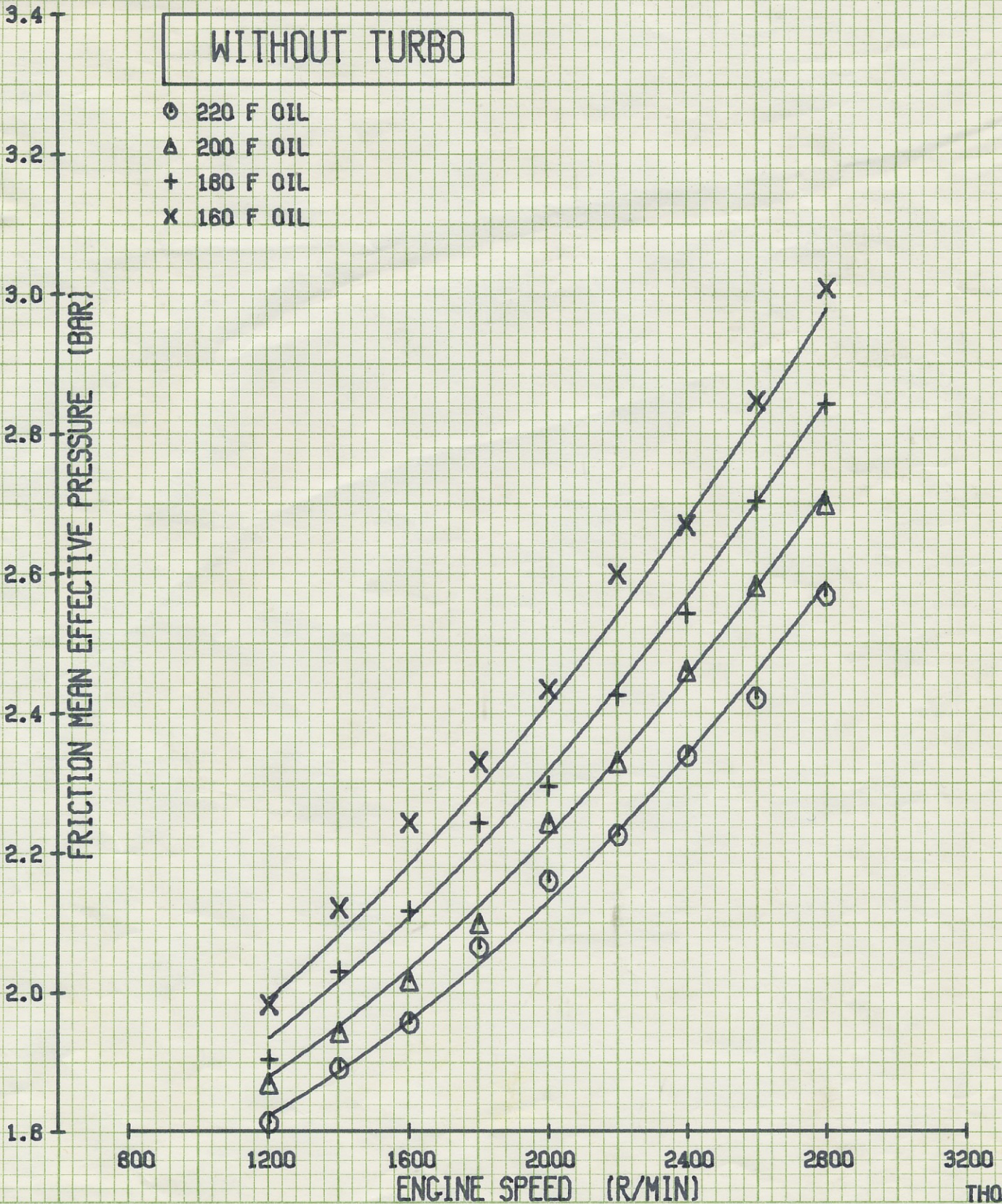


4T-390 40521138

FRICITION POWER
FAMILY-1 PHASE-3
4CYL TURBOCHARGED

WITHOUT TURBO

- ⊙ 220 F OIL
- △ 200 F OIL
- + 180 F OIL
- X 160 F OIL



THOMMEN
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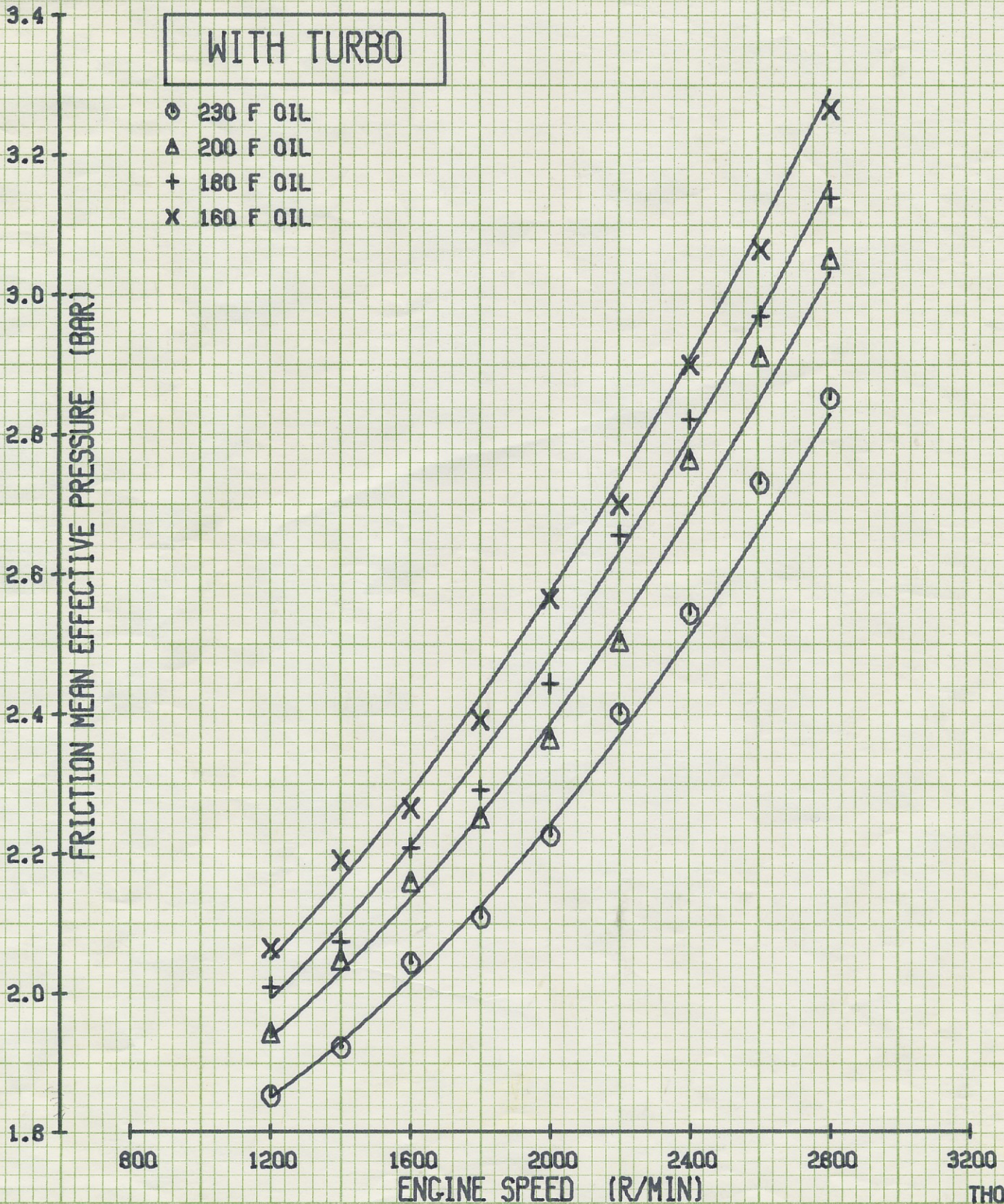


4T-390 40521138

FRICION POWER
FAMILY-1 PHASE-3
4CYL TURBOCHARGED

WITH TURBO

- ⊙ 230 F OIL
- △ 200 F OIL
- + 180 F OIL
- X 160 F OIL



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