**PP&L** | **CALCULATION COVER SHEET**

| | |
|---|---|
| CALC. NO. | [illegible]-DEA-026 |
| FILE NO. | R-2-1M |
| SUPERSEDED BY | |

SAFETY-RELATED [ ]
ASME III OR XI [ ]
OTHER QUALITY [ ]
NON QUALITY [X]

PROJECT ________ ER/CTN NO. ________

DESIGN ACTIVITY/PMR NUMBER ________ PAGE 1 OF 9

TITLE/DESCRIPTION PISTON TOGGLING CALC.

SYSTEMS AFFECTED DIESEL GENERATOR

**STATEMENT OF PROBLEM**

THE DIESEL PISTON HAS THREE DIAMETERS, THE SMALLEST OF WHICH IS AT THE TOP. IF THE PISTON COCKS, DETERMINE WHERE THE PISTON FIRST TOUCHES THE LINER I.E. TOP OR SOMEWHERE ELSE.

**DESIGN BASIS (EPM-QA-208 OR EPM-QA-400)**

THESE INPUTS ARE IN LIEU OF EPM-QA-208 INPUTS.

THE DIMENSIONS OF THE PISTON AND LINER ARE TAKEN TO BE THE AVERAGE OF THE DIMENSIONS SHOWN ON THE ATTACHED DRAWING FROM C-B.

**REFERENCES/FORMULAE**

C-B PISTON DRAWING ATTACHED.

**SUMMARY/CONCLUSIONS**

THE COCKED PISTON WILL FIRST TOUCH THE LINER JUST BELOW THE SECOND OIL RING, SEE PAGE 9.

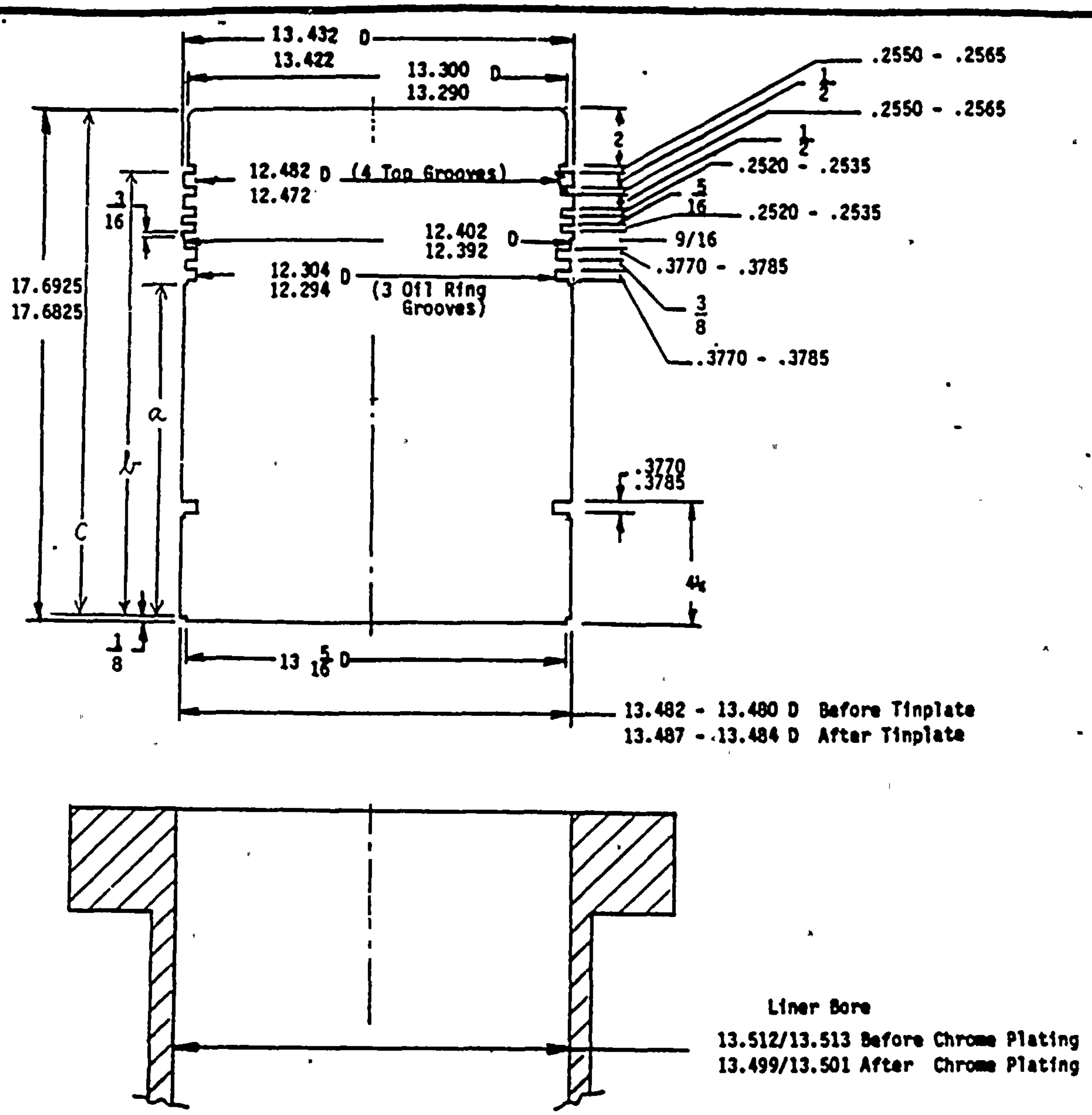
**ENGINEERING TURNOVER**
(ETO) BINDER AFFECTED? [ ] YES-If Yes enter: Binder # ________ Vol. ________
Calc. File ________ Pgs. ________
[ ] NO

| REV. NO. | DATE | PREPARED BY | REVIEWED/CHECKED BY | DATE | APPROVED BY | DATE |
|---|---|---|---|---|---|---|
| 0 | 2/14/90 | Frank J Czyz | R.M. Centenaro | 2/14/90 | H R Clarke | 2/16/90 |
| | | | | | | |
| | | | | | | |

FORM EPM-QA-216A REV.1

mls/frb006i(12)

9003010366 900222
PDR ADOCK 05000387
P PDC




Ref Power Piston KSV-5-A
Liner-Power G18-9-12A#2

KSV PISTON/LINER - DETAIL

| | | |
|---|---|---|
| DRWN. BY | BMcL | COOPER ENERGY SERVICES |
| CHKD. BY | | |
| APPR. BY | | |
| SCALE | | A COOPER-BESSEMER PRODUCT |
| SHEET 1 OF 1 SHEETS | | QCS-6543 |

| REV. NO. | | REVISION | DATE |
|---|---|---|---|
| ISSUE | | | NOV 20'89 |

103 PRINTED IN U.S.A.

PP&L Form 2454 (10/83)
Cat. #973401

Dept. ______
Date ______ 19____
Designed by ______
Approved by ______

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT ______

~~ER No.~~ M-DEA-026

Sht. No. 3 of 9

Dimensions 'a', 'b' & 'c' will be the difference between the overall length and individual lengths of the crown, ring grooves and lands, as appropriate. (Average dimensions wills will be used.)

c = (17.6925" + 17.6825")/2 − 1/8" = 17.5625" ✓

b = c − 2" − 0.2558" = 15.3067" ✓

a = b − 1/2" − 0.2558" − 1/2" − 0.2528" − 5/16" − 0.2528"
− 9/16" − 0.3778" − 3/8" − 0.3778 = 11.5397" ✓

Note: the small step below the lower oil ring and the skirt area will be ignored since no dimension is given and based on seeing a piston this dimension is small.

The diameters of interest at the calculated piston heights are as follows:

ϕ @ c = 13.295"
ϕ @ b = 13.427"
ϕ @ a = 13.486"

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Dept. ____________

Date ________ 19______

Designed by ________

Approved by ________

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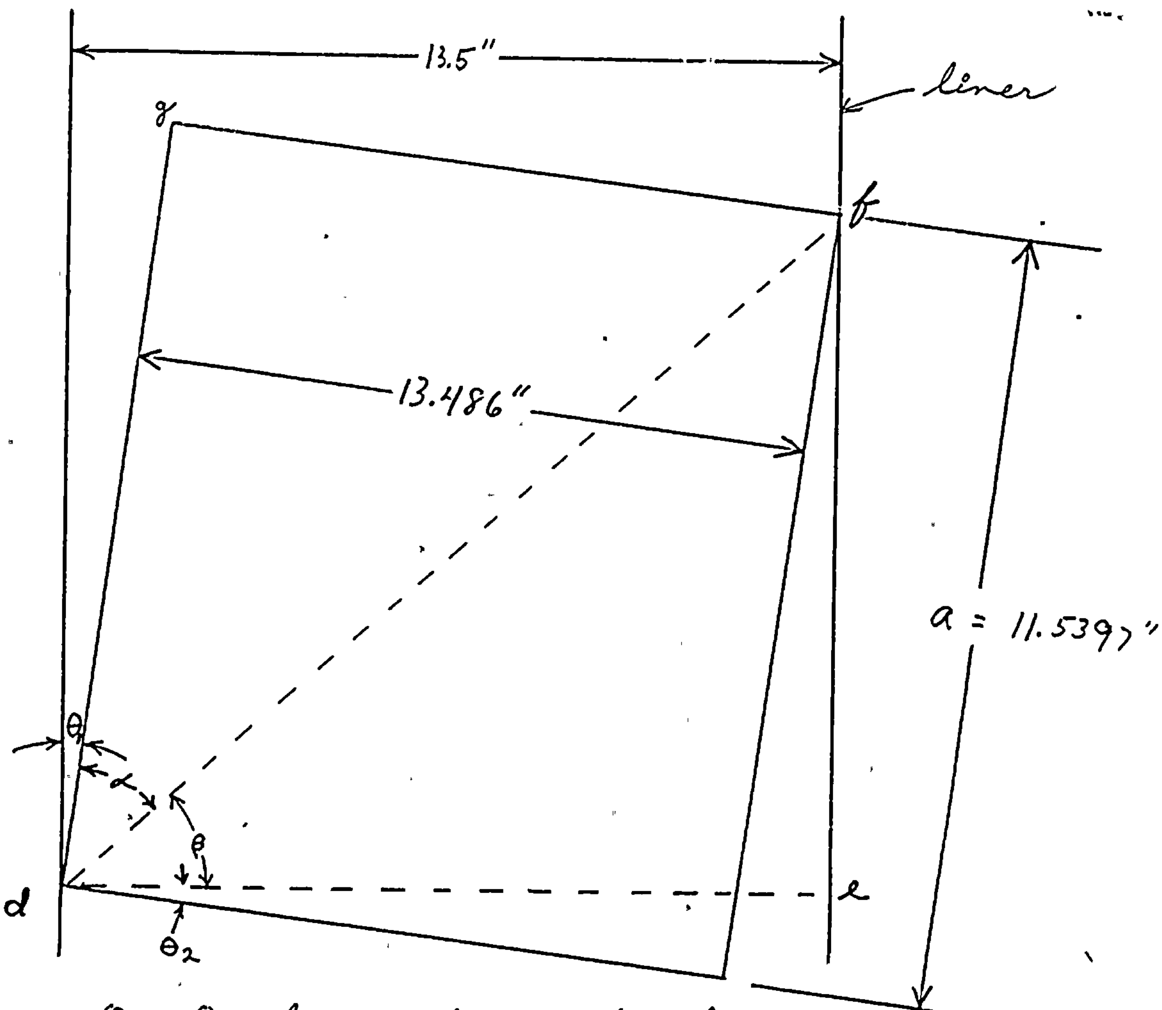
**CALCULATION SHEET**

PROJECT______________________

~~ER No.~~ M-DEA-026

Sht. No. 4 of 9

Determine the angle of rotation needed to have piston contact liner at height "a".




$\theta_1 = \theta_2$ by similiar angles law

Note: when point f of the piston touches the liner the hypotenuse of triangle d e f and triangle d f g is the same length

PP&L Form 2454 (10/83)
Cat. #973401

| | | |
|---|---|---|
| Dept. ________ <br> Date ________ 19____ <br> Designed by ________ <br> Approved by ________ | **PENNSYLVANIA POWER & LIGHT COMPANY** <br> **CALCULATION SHEET** <br> PROJECT ________ | ER No. M-DEA-026 <br> Sht. No. 5 of 9 |

Determine angle $\theta$

$$\theta = 90° - \alpha - \beta$$

$$= 90° - \tan^{-1}\left(\frac{gf}{dg}\right) - \cos^{-1}\left(\frac{\overline{de}}{df}\right)$$

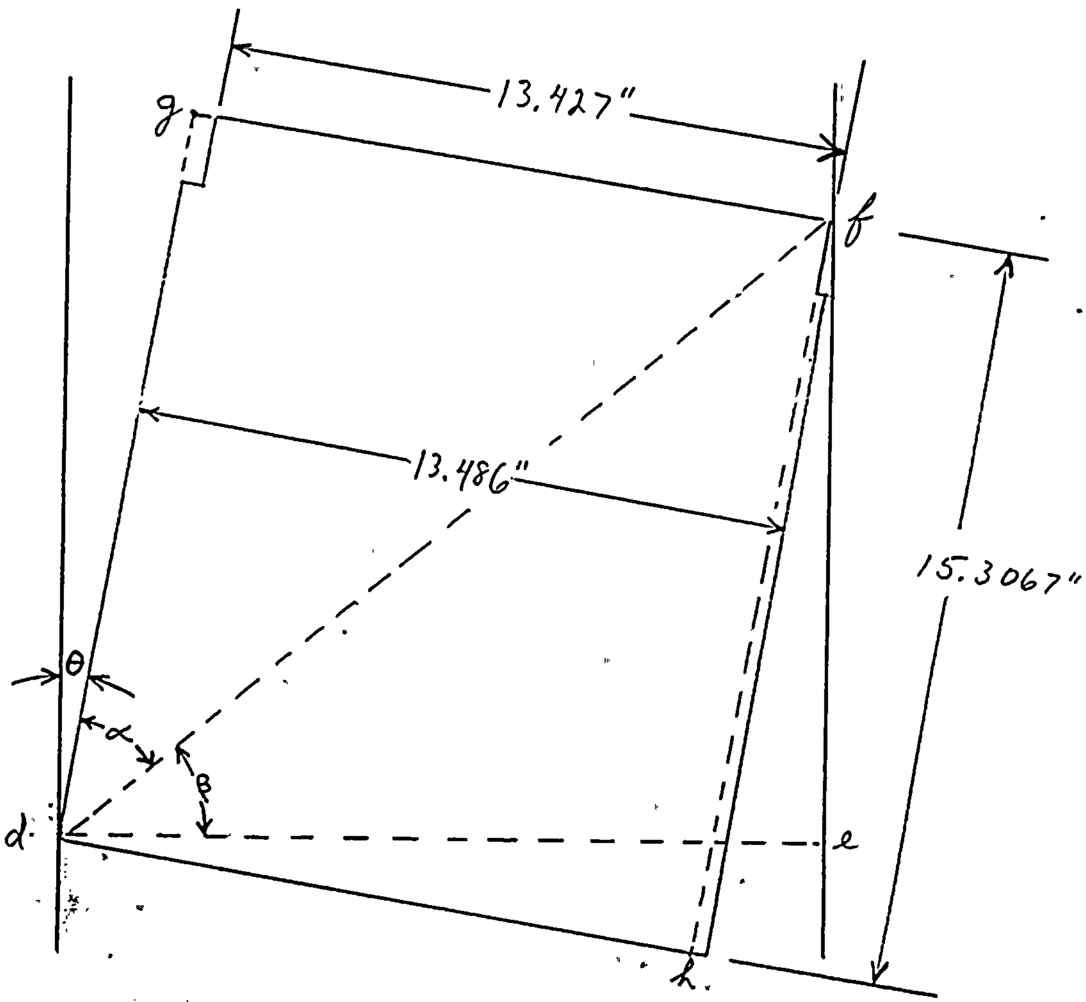
$$= 90° - \tan^{-1}\left(\frac{13.486}{11.5397}\right) - \cos^{-1}\frac{13.5}{\sqrt{13.486^2 + 11.5397^2}}$$

$$\theta = 0.06956°$$

PP&L Form 2454 (10/83)
Cat. #973401

| | | |
|---|---|---|
| Dept. | PENNSYLVANIA POWER & LIGHT COMPANY CALCULATION SHEET | ER No. M-DEA-026 |
| Date 19 | PROJECT | Sht. No. 6 of 9 |
| Designed by | | |
| Approved by | | |

Determine the angle of rotation need to have the piston contact the liner at height "b".




length $\overline{gf}$ = 13.427 + (13.486 − 13.427)/2

= 13.4565

length $\overline{dh}$ = $\overline{gf}$ = 13.4565

PP&L Form 2454 (10/83)
Cat. #973401

| | | |
|---|---|---|
| Dept. ______ | **PENNSYLVANIA POWER & LIGHT COMPANY** | ER No. M-DEA-026 |
| Date ______ 19____ | **CALCULATION SHEET** | |
| Designed by ______ | PROJECT ______ | Sht. No. 7 of 9 |
| Approved by ______ | | |

Determine angle θ β

$$\theta = 90^\circ - \tan^{-1}\left(\frac{\overline{gf}}{gd}\right) - \cos^{-1}\left(\frac{\overline{de}}{df}\right)$$

$$= 90^\circ - \tan^{-1}\left(\frac{13.4565}{15.3067}\right) - \cos^{-1}\left(\frac{13.5}{\sqrt{13.4565^2 + 15.3067^2}}\right)$$

$$\theta : 0.1630^\circ$$ ✓

PP&L Form 2454 (10/83)
Cat. #973401

Dept. ______
Date ______ 19____
Designed by ______
Approved by ______

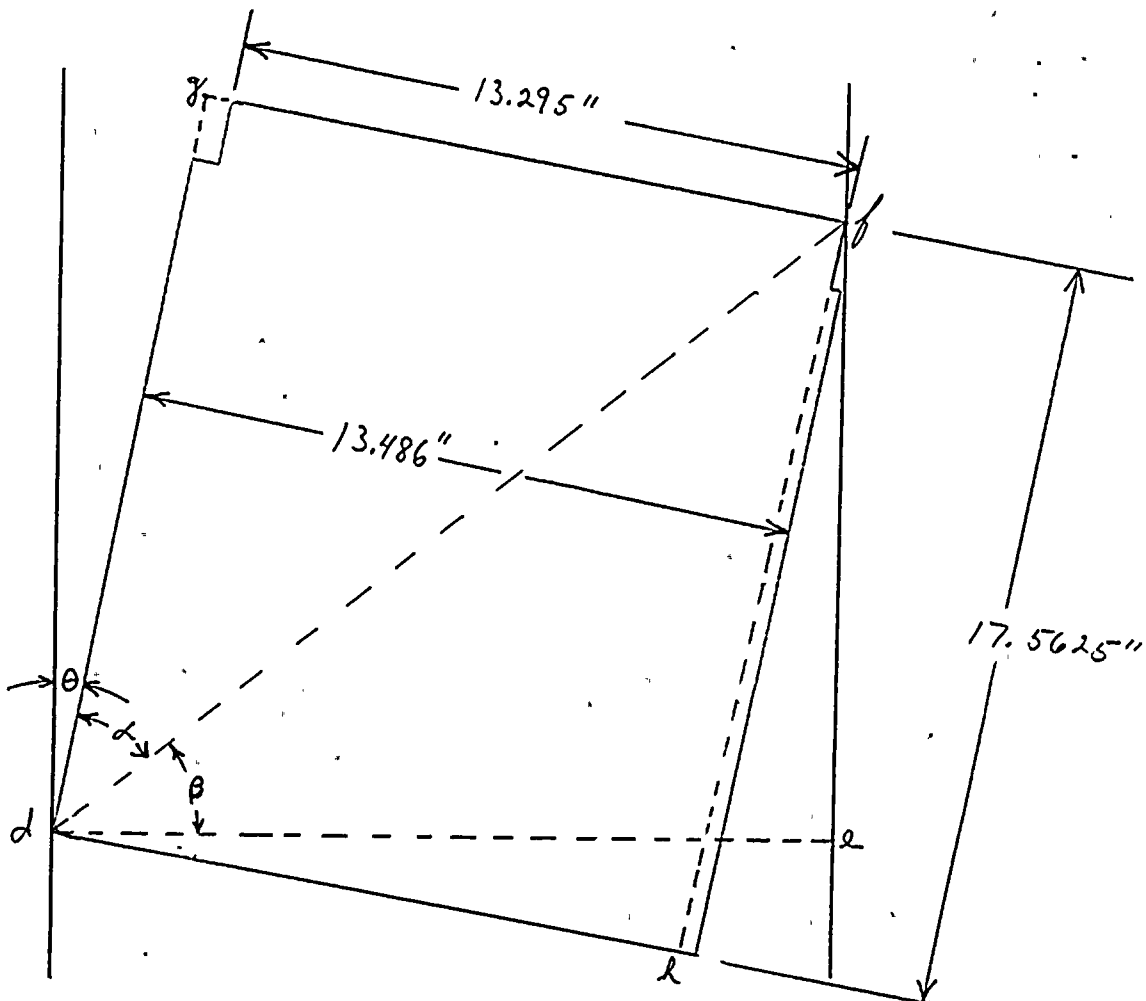
PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT ______

~~ER No.~~ M-DEA-026

Sht. No. 8 of 9

Determine the angle of rotation needed to have piston contact liner at height "c". The piston will be drawn without the intermediate diameter at hieght "b".




length $\overline{gf}$ = 13.295" + (13.486 − 13.295)/2
= 13.3905"

length $\overline{dh}$ = $\overline{gf}$

PP&L Form 2454 (10/83)
Cat. #973401

Dept. ______________
Date ________ 19______
Designed by ________
Approved by ________

**PENNSYLVANIA POWER & LIGHT COMPANY**
**CALCULATION SHEET**

PROJECT ______________

~~ER No.~~ M-DEA-026



Determine angle θ

$$\theta = 90^\circ - \tan^{-1}\left(\frac{\overline{gf}}{\overline{dg}}\right) - \cos^{-1}\left(\frac{\overline{de}}{\overline{df}}\right)$$

$$= 90^\circ - \tan^{-1}\left(\frac{13.3905}{17.5625}\right) - \cos^{-1}\left(\frac{13.5''}{\sqrt{13.3905^2 + 17.5625^2}}\right)$$

$$= 0.3581^\circ$$

<u>Conclusion</u>

The piston contacting the liner at heights "a", "b", & "c" will required the following angles of rotation:

| height | angle |
|---|---|
| a | 0.06956° |
| b | 0.1630° |
| c | 0.3581° |

Therefore it is concluded that the piston will contact the liner first at height "a" since it requires the least amount of rotation.

## ATTACHMENT 2 TO PLA-3350

**Peak Firing Pressures and Engine Balance**

PP&L was asked to comment on exceeding 1690 psi maximum average peak firing pressure. The 1690 psi maximum average firing pressure represents the maximum average pressure a balanced engine is expected to produce at full load. A review of the latest engine analyzer data for engines A-D (reference 1/29/90 memo to E.W. Figard from J.R. Adams) indicates those engines need to be balanced. Diesel generator E is within the balance parameters (reference 2/13/90 memo to E.W. Figard from J.R. Adams) at 4000 kw (the load it is expected to operate at after a DBA) but slightly out of balance at its full load rating of 5000 kw.

Running an engine out of (firing) balance will cause the engine to run rough and may have some long term effects if the imbalance is severe enough and left uncorrected. A review of the analyzer data indicates that only the C engine exceeds the 1690 maximum average peak pressure (by 25 psi) at 4000 kw. However, engines A-D exceed the 160 psi maximum deviation between cylinders. This is due to a problem on a few cylinders causing low peak firing pressures (presumably due to injection pump timing).

PP&L recognizes that the engines need to be balanced and this will be done during the 18 month inspections. The schedule for these inspections has been forwarded to you under PLA. Recognize that after balanced engines run for a period of time they will exceed the balanced engine criteria. We are now at this point and have scheduled the balancing. Even though the engines are outside the balance criteria they are capable of performing their design intent. Engine imbalance will not affect the engines' ability to carry load or accelerate to rated speed as evidenced by the engines passing all surveillance tests.

PP&L

cc: K. L. Tutorow - SSES
D. F. Sitler - SSES
M. M. Heidorn - SSES
F. J. Czysz - A6-3
W. J. Rhoades - A6-2

January 29, 1990

TO: E. W. Figard

SUBJ: Diesel Generator Load Balance

The current criteria established by Cooper-Bessemer to determine if the engine is balanced is listed below:

1. Maximum average firing pressure is 1690 psi, stated in C-B Bulletin 711-A; however C-B states that it really means the average of one cylinder not the average of all.

2. Maximum firing pressure variation between cylinders is 160 psi.

3. Fuel injection pump timing must be set between 29-30$^{\circ}$ Before Top Center.

4. Maximum variation on fuel pump rack settings at fuel load is 1/2 mm.

I reviewed each of the latest D/G analyzer data sheets and the results are attached.

I recommend the following actions:

1. OG501A

   - Replace fuel injection nozzles 1L, 2L, & 2R.
   - Recheck firing pressures.

2. OG501B

   - Analyzer data is suspect, therefore, perform another engine analysis.

3. OG501C

   o Engine is severely unbalanced and steps should be taken to balance engine prior to 3/1/90.

4. OG501D

   o There is no current post 18-month surveillance analyzer data to review, therefore, an engine analysis should be performed.

5. OG501E

   o Engine is in balance; however, a post 18 month surveillance engine analysis should be performed.

6. The EN-SPEC 1000 engine analyzer should be repaired and personnel instructed in its use so that firing pressures can be taken during trouble shooting.

7. Cooper-Bessemer still needs to provide us with their balancing procedure at which time an MT will be required to balance the engine.

JRAdams

J. R. Adams

JRA/pag

PP&L Form 2454 (10/83)
Cat #973401

OG 501 A

DATE TESTED 1/5/90

Dept. MAINT
Date ________ 19____
Designed by JRA
Approved by ________

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT DIESEL GENERATOR LOAD BALANCE

ER No. ________

Sht. No. ______ of ______

| CYL NO | HP | IMEP | PRESSURE ANGLE | FP |
|---|---|---|---|---|
| 1L | 436 | 236 | 10 | 1409 |
| 2L | 626 | 338 | 21 | 1284 |
| 3L | 477 | 258 | 11 | 1579 |
| 4L | 475 | 256 | 12 | 1561 |
| 5L | 500 | 270 | 11 | 1648 |
| 6L | 497 | 268 | 11 | 1649 |
| 7L | 489 | 264 | 11 | 1624 |
| 8L | 555 | 300 | 15 | 1604 |
| 9L | — | — | — | — |
| 10L | — | — | — | — |
| 1R | 533 | 298 | 16 | 1531 |
| 2R | 461 | 257 | 15 | 1441 |
| 3R | 491 | 274 | 11 | 1675 |
| 4R | 462 | 258 | 11 | 1575 |
| 5R | 534 | 298 | 14 | 1602 |
| 6R | 513 | 287 | 14 | 1595 |
| 7R | 495 | 276 | 13 | 1538 |
| 8R | 487 | 272 | 14 | 1599 |
| 9R | — | — | — | — |
| 10R | — | — | — | — |

avg 1556.6

AIR MANIFOLD TEMP 60/65 °F
MAX FIRING PRESSURE 1675 PSI
MIN ALLOWABLE FIRING PRESSURE 1515 PSI

REMARKS

(1) Cylinders 1L, 2L & 2R are out of tolerance with low firing pressures

(2) WA submitted to replace 2L fuel injection nozzle

(3) Analyzer used - EN-SPEC 3000

PP&L Form 2454 (10-83)
Cat #973401

OG 501 B

DATE TESTED 1/23/89

Dept. MAINT
Date ______ 19____
Designed by JRA
Approved by ______

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT DIESEL GENERATOR LOAD BALANCE

ER No. ______
Sht. No. ____ of ____

| CYL NO | HP | IMEP | PRESSURE ANGLE | FP |
|---|---|---|---|---|
| 1L | 581 | 313 | 16 | 1603 |
| 2L | 647 | 349 | 19 | 1470 |
| 3L | 564 | 305 | 12 | 1688 |
| 4L | 550 | 297 | 14 | 1727 |
| 5L | 542 | 293 | 13 | 1774 |
| 6L | 539 | 291 | 12 | 1676 |
| 7L | 597 | 322 | 16 | 1623 |
| 8L | 541 | 292 | 14 | 1643 |
| 9L | – | – | – | – |
| 10L | – | – | – | – |
| 1R | 573 | 309 | 17 | 1508 |
| 2R | 532 | 287 | 15 | 1612 |
| 3R | 634 | 343 | 19 | 1516 |
| 4R | 546 | 295 | 14 | 1652 |
| 5R | 553 | 298 | 15 | 1606 |
| 6R | 559 | 302 | 15 | 1589 |
| 7R | 536 | 289 | 14 | 1684 |
| 8R | 613 | 331 | 20 | 1439 |
| 9R | – | – | – | – |
| 10R | – | – | – | – |

AIR MANIFOLD TEMP ______ °F
MAX FIRING PRESSURE 1774 PSI
MIN ALLOWABLE FIRING PRESSURE 1614 PSI

REMARKS

(1) 4L & 5L are out of tolerance with high firing pressures

(2) 1L, 2L, 1R, 2R, 3R, 5R, 6R & 8R are out of tolerance with low firing pressures

(3) If 4L & 5L are corrected then only 2L, 1R, 3R & 8R would be out-of tolerance low.

(4) This data taken prior to 3/89 18 month surveillance.

PP&L Form 2354 (12-33)
Cat #973401

OG 501 B

DATE TESTED 11/9/89

Dept. MAINT
Date ________ 19____
Designed by JRA
Approved by ________

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT DIESEL GENERATOR LOAD BALANCE

ER No. ________

Sht. No. ____ of ____

| CYL NO | HP | IMEP | PRESSURE ANGLE | FP |
|---|---|---|---|---|
| 1L | 405 | 222 | 12.1 | 1540 |
| 2L | 368 | 200 | 10.3 | 1611 |
| 3L | 382 | 208 | 35.5 | 1341 |
| 4L | 378 | 207 | 10.3 | 1670 |
| 5L | 366 | 199 | 10.2 | 1667 |
| 6L | 324 | 174 | 14.2 | 1584 |
| 7L | 369 | 199 | 17.5 | 1591 |
| 8L | 350 | 191 | 9.6 | 1646 |
| 9L | – | – | – | – |
| 10L | – | – | – | – |
| 1R | 371 | 202 | 13.0 | 1362 |
| 2R | 327 | 172 | 15.9 | 1449 |
| 3R | 387 | 208 | 23.3 | 1460 |
| 4R | 381 | 205 | 15.5 | 1572 |
| 5R | 368 | 200 | 10.7 | 1595 |
| 6R | 353 | 191 | 11.1 | 1592 |
| 7R | 353 | 192 | 16.4 | 1587 |
| 8R | 446 | 245 | 23.8 | 1513 |
| 9R | – | – | – | – |
| 10R | – | – | – | – |

1548.8

AIR MANIFOLD TEMP ________ °F
MAX FIRING PRESSURE 1670 PSI
MIN ALLOWABLE FIRING PRESSURE 1510 PSI

1.4
329

REMARKS

(1) Cylinders 3L, 1R, 2R & 3R are out of tolerance with low firing pressures

(2) Analyzer used BETA-250 (Equip Services corp ran analyzer and may not have understood operation of analyzer – Data suspect)

PP&L Form 2454 (10-83)
Cat #973401

OG 501 C

DATE TESTED 12/29/89

Dept. MAINT
Date ________ 19____
Designed by JRA
Approved by ________

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT DIESEL GENERATOR LOAD BALANCE

ER No. ________

Sht. No. ____ of ____

| CYL NO | HP | IMEP | PRESSURE ANGLE | FP |
|---|---|---|---|---|
| 1L | 310 | 179 | 12.5 | 1453 |
| 2L | 335 | | 8.5 | 1530 |
| 3L | 384 | 218 | 16.7 | 1649 |
| 4L | 360 | 200 | 28 | 1624 |
| 5L | 360 | 202 | 9 | 1770 |
| 6L | 360 | 202 | 10.3 | 1724 |
| 7L | 343 | 193 | 10.0 | 1518 |
| 8L | 374 | 210 | 11.0 | 1778 |
| 9L | — | — | — | — |
| 10L | — | — | — | — |
| 1R | 333 | 185 | 8.7 | 1829 |
| 2R | 343 | 191 | 8.5 | 1913 |
| 3R | 369 | 204 | 10.8 | 1764 |
| 4R | 364 | 204 | 10.2 | 1713 |
| 5R | 382 | 214 | 11.3 | 1765 |
| 6R | 369 | 206 | 9.9 | 1842 |
| 7R | 390 | 219 | 11.5 | 1751 |
| 8R | 336 | 188 | 9.4 | 1821 |
| 9R | — | — | — | — |
| 10R | — | — | — | — |

avg 1715.3

AIR MANIFOLD TEMP ________ °F
MAX FIRING PRESSURE 1913 PSI
MIN ALLOWABLE FIRING PRESSURE ________ PSI
mini 1453
Δ 460

REMARKS
(1) Engine is severly out of balance
(2) Right cam shaft may need retimed.
(3) Analyzer used BETA-250 (Equipment Services Corp personnel appeared to understand the operation of the analyzer.

PP&L Form 2454 (10-83)
Cat #973401

OG 501 D

DATE TESTED 1/23/89

Dept. MAINT

Date ______ 19____

Designed by JRA

Approved by ______

**PENNSYLVANIA POWER & LIGHT COMPANY**
**CALCULATION SHEET**

PROJECT DIESEL GENERATOR LOAD BALANCE

ER No. ______

Sht. No. ____ of ____

| CYL NO | HP | IMEP | PRESSURE ANGLE | FP |
|---|---|---|---|---|
| 1L | 524 | 283 | 12 | 1587 |
| 2L | 628 | 339 | 19 | 1432 |
| 3L | 557 | 301 | 14 | 1625 |
| 4L | 577 | 312 | 15 | 1609 |
| 5L | 553 | 299 | 14 | 1694 |
| 6L | 533 | 288 | 12 | 1673 |
| 7L | 533 | 287 | 12 | 1776 |
| 8L | 544 | 294 | 14 | 1706 |
| 9L | — | — | — | — |
| 10L | — | — | — | — |
| 1R | 627 | 350 | 20 | 1469 |
| 2R | 564 | 315 | 14 | 1726 |
| 3R | 562 | 314 | 12 | 1728 |
| 4R | 548 | 306 | 14 | 1675 |
| 5R | 605 | 338 | 14 | 1694 |
| 6R | 536 | 300 | 12 | 1714 |
| 7R | 570 | 318 | 16 | 1655 |
| 8R | 508 | 284 | 13 | 1669 |
| 9R | — | — | — | — |
| 10R | — | — | — | — |

avg. 1651.4

AIR MANIFOLD TEMP ______ °F
MAX FIRING PRESSURE 1776 PSI
MIN ALLOWABLE FIRING PRESSURE 1616 PSI
min 1432
Δ 344

REMARKS

(1) Cylinders 5L, 7L, 8L, 5R & 6R are out of tolerance with high firing pressure

(2) Cylinders 1L, 2L, 4L & 1R are out of tolerance with low firing pressures; however when the high firing pressures are corrected only the 2L & 1R would be out of tolerance

(3) Analyzer used was EN SPEC 3000

(4) This data was taken prior to 2/89 18 month

PP&L Form 2454 (10-83)
Cat #973401

OG 501 E

DATE TESTED 1/4/90

Dept. MAINT
Date ______ 19____
Designed by JRA
Approved by ______

PENNSYLVANIA POWER & LIGHT COMPANY
CALCULATION SHEET

PROJECT DIESEL GENERATOR LOAD BALANCE

ER No. ______

Sht. No. ____ of ____

| CYL NO | HP | IMEP | PRESSURE ANGLE | FP |
|---|---|---|---|---|
| 1L | 400 | 216 | 10 | 1479 |
| 2L | 430 | 232 | 11 | 1431 |
| 3L | 426 | 230 | 12 | 1450 |
| 4L | 421 | 227 | 11 | 1494 |
| 5L | 443 | 239 | 12 | 1517 |
| 6L | 418 | 226 | 11 | 1425 |
| 7L | 429 | 232 | 10 | 1509 |
| 8L | 403 | 217 | 13 | 1409 |
| 9L | 430 | 232 | 12 | 1467 |
| 10L | 447 | 241 | 12 | 1492 |
| 1R | 382 | 213 | 10 | 1437 |
| 2R | 389 | 217 | 12 | 1526 |
| 3R | 387 | 216 | 11 | 1527 |
| 4R | 392 | 219 | 11 | 1507 |
| 5R | 413 | 230 | 10 | 1575 |
| 6R | 372 | 208 | 9 | 1499 |
| 7R | 381 | 213 | 11 | 1491 |
| 8R | 366 | 204 | 10 | 1453 |
| 9R | 402 | 224 | 10 | 1551 |
| 10R | 399 | 222 | 12 | 1463 |

avg 1485.1

AIR MANIFOLD TEMP 45 °F
MAX FIRING PRESSURE 1575 PSI
MIN ALLOWABLE FIRING PRESSURE 1415 PSI

min 1409
Δ 166

REMARKS

(1) Readings on 8L cylinder are low since the cylinder test cock was leaking badly; therefore, disregard 8L readings

(2) Analyzer used was the EN SPEC 3000

(3) This engine is "in balance"

**PP&L** MEMORANDUM



TO: E.W. FIGARD DATE: 2/13/90

FROM: JR Adams

JOB: NUMBER: COPIES TO: D.F. Saler

FILE: REPLY: S.B. Kuhn

F.J. Czysz

NRC (4 copies)

SUBJECT: OG501E Engine Analyzer Data

Attached is data for 1/4, 2/6, & 2/12/90. The following is additional data needed for a complete analysis

- 1/4/90
  - Analyzer used — Enspec 3000
  - Ambient outside temp — 40.2 °F
  - Spray Pond Temp — 36 °F
  - Engine Load — 4000 KW
- 2/6/90
  - Analyzer used — Enspec 1000
  - Ambient outside temp — 37.8 °F
  - Spray Pond Temp — 65 °F
  - Engine Load — 4000 KW
- 2/12/90
  - Analyzer used — Enspec 1000 & 3000
  - Ambient outside temp — 35 °F
  - Spray Pond Temp — 70 °F
  - Engine Load — 5000 KW
- 2/12/90
  - Analyzer used — Enspec 1000
  - Ambient outside temp 33 °F
  - Spray Pond Temp — 70 °F
  - Engine Load — 4000 KW

PP&L

MEMORANDUM
(CONTINUATION SHEET)

PAGE____ OF____
NUMBER:

As a result of perform a balance run at 4000 KW and air manifold temperature the following rework is being conducted:

- Reshim fuel pump 2L, 10L, 1R, 4R to retard timing
- Reset all fuel racks so that the maximum variation between pumps does not exceed 0.5 millimeters

Following rework listed above the following testing still needs to be completed.

- 4000 KW run with warm air manifolds to check balancing
- Rework fuel injection pumps as necessary to achieve correct balance
- 4000 KW confirmation of balance run at warm air temp.
- 5000 KW run with warm air manifolds
- 5000 KW run with cold air manifolds.
- 2500 KW run with cold air manifolds

The En Spec 1000 analyzer will be utilized for all runs and the En Spec 3000 will be used in conjunction with the 1000 for only the balancing runs.

HCAdams

AP010.0-B2 REV. 1

# O[redacted]501 E ENGINE AN[redacted]YZER DATA

| DESCRIPTION | 1/4/90 FP | 1/4/90 DEV | 2/6/90 FP | 2/6/90 DEV | 2/12/90 FP | 2/12/90 DEV | 2/12/90 FP | 2/12/90 DEV |
|---|---|---|---|---|---|---|---|---|
| 1L | 1479 | – | 1519 | 32 | 1671 | 38 | 1494 | 20 |
| 2L | 1431 | – | 1511 | 30 | 1684 | 26 | 1511 | 19 |
| 3L | 1450 | – | 1453 | 26 | 1651 | 26 | 1480 | 22 |
| 4L | 1494 | – | 1529 | 29 | 1683 | 34 | 1531 | 25 |
| 5L | 1517 | – | 1537 | 34 | 1739 | 27 | 1550 | 22 |
| 6L | 1425 | – | 1416 | 27 | 1603 | 22 | 1437 | 27 |
| 7L | 1509 | – | 1499 | 21 | 1667 | 23 | 1483 | 19 |
| 8L | 1409 | – | 1513 | 34 | 1726 | 37 | 1540 | 23 |
| 9L | 1467 | – | 1556 | 29 | 1766 | 25 | 1552 | 19 |
| 10L | 1492 | – | 1539 | 31 | 1727 | 25 | 1536 | 22 |
| 1R | 1437 | – | 1582 | 42 | 1731 | 33 | 1548 | 20 |
| 2R | 1526 | – | 1507 | 32 | 1673 | 20 | 1499 | 20 |
| 3R | 1527 | – | 1497 | 27 | 1653 | 33 | 1474 | 19 |
| 4R | 1507 | – | 1574 | 31 | 1739 | — | 1554 | 25 |
| 5R | 1575 | – | 1550 | 29 | 1742 | 27 | 1521 | 16 |
| 6R | 1499 | – | 1569 | 28 | 1754 | 41 | 1540 | 25 |
| 7R | 1491 | – | 1537 | 30 | 1733 | 34 | 1508 | 16 |
| 8R | 1453 | – | 1508 | 29 | 1685 | 26 | 1486 | 12 |
| 9R | 1551 | – | 1524 | 27 | 1728 | 17 | 1505 | 15 |
| 10R | 1463 | – | 1485 | 29 | 1668 | 23 | 1475 | 19 |
| TOTAL | 29702 | | 30405 | | 34023 | | 30224 | |
| MAX AVE F.P | 1485 | | 1520 | | 1701 | | 1511 | |
| HIGH FP | 1575 | | 1582 | | 1766 | | 1554 | |
| LOW FP | 1409 | | 1416 | | 1603 (Δ 163) | | 1437 (Δ 117) | |
| LOAD KW | 4000KW | | 4000KW | | 5000KW | | 4000 KW | |
| AIR MANIFOLD R/L | 45/45 | | 66/66 | | 76/78 | | 100/101 | |