

5HSRUW 1R 1&3 53
5HSRUW 'DWH 0DUFK

5HY 1

6ROYD\)RUPHUO\ \$GYDQFHG &R
070 &) 5: . 3: \$6)DEULF
FXUH F\FOH FRPSDUHG WR 0+
(TXLYDOHQF\ 6WDWLVLWLFDO \$

)\$\$ 6SHFLDO 3URMHFW 1XPEHU 63 : , 4

1&\$03 'RFXPHQW 1&3 53 5HY 1 &

5HSRUW 'DWH 0DUFK

(OL]DEHWK &ODUNVRQ 3K '

1DWLRQDO &HQWHUWRULSDO QFHGRUDDQFH 1&\$03
1DWLRQDO ,QVWLWXWH IRU \$YLDWLRQ 5HVHDUFK
:LFKLWD 6WDWH 8QLYHUVLW\
:LFKLWD .6

7HVWLQJ)DFLOLW\
6ROYD\)RUPHUO\ \$GYDQFHG &RPSRVLWHV *URXS
6RXWK WK (DVW \$YHQXH
7XOVD 2.

7HVW 3DQHO)DEULFDWLRQ)DFLOLW\
6ROYD\)RUPHUO\ \$GYDQFHG &RPSRVLWHV *URXS
6RXWK WK (DVW \$YHQXH
7XOVD 2.

'LVWULEXWLRQ 6SDWRPHQWR\$ SXEOLF UHOHDVH GLVWU

5HSRUW 1R 3 1&3 5 5HY 1 &
5HSRUW 'DWH 0DUFK

3UHSDUHG E\

(OL]DEHWK &ODUNVRQ

5HYLHZHG E\

-RQDWKDQ 7LVDFN

.DWKHUL

\$SSURYHG E\

5R\DO /RYLQJIRVV

7\$%/(2) &217(176

,QWURGXFWLRQ

6\PEROV DQG \$EEUHYLDWLRQV

%DFNJURXQG

5HVXOWV &RGHV

(TXLYDOHQF\ &RPSXWDWLRQV

+ \SRWKHVLV 7HVWLQJ

7\SH , DQG 7\SH ,, (UURUV

&XPXODWLYH (UURU 3UREDELOLW\

6WUHQJWK DQG ORGXOXV 7HVWV

ORGLILHG &RHIILFLHQW RI 9DULDWLRQ

(TXLYDOHQF\ 7HVW 5HVXOWV

:DUS &RPSUHVVLRQ :&

:DUS 7HQVLRQ :7

)LOO &RPSUHVVLRQ)&

)LOO 7HQVLRQ)7

/DPLQD 6KRUW %HDP 6WUHQJWK 6%6

,Q 3ODQH 6KHDU ,36

3 2SHQ +ROH 7HQVLRQ 2+7

3 2SHQ +ROH &RPSUHVVLRQ 2+&

,QWHUODPLQDU 7HQVLRQ ,/7 DQG &XUYHG %HDP 6WUH

&RPSUHVVLRQ \$IWHU ,PSDFW &\$,

&XUHG 3O\ 7KLFNQHVV &37

6XPPDU\ RI 5HVXOWV

7KH DVVXPSWLRQ RI ,QGHSHQGHHQH

)DLOXUHV

3DVV 5DWH

3UREDELOLW\ RI)DLOXUHV

5HIHUHQFH

/LVW RI 7DEOHV

7DEOH 7HWW \$EUBHHDQV
 7DEOH (QYLURQQEHVWDOOV &\$EEUHYLDWLRQV
 7DEOH 2QH VLG HFGWRB O H B D CQFLP LDV VYDQ XHVP SOH PHDQ
 7DEOH 2QH VLG HFGWRB O H B D CQFLP LDV VYDQ XHVP SOH PHDQ
 7DEOH)DLOXHG W V 6FDOH
 7DEOH 6XPPDUORQFTXLYWV 5HVXOWV
 7DEOH :DUSV &RPSUHQVHWXOWV
 7DEOH :DUSV &RPSUHQVHWXOWV
 7DEOH :DUSV &RPSUHQVHWXOWV
 7DEOH :DUSV &RPSUHQVHWXOWV
 7DEOH :DUSV &RPSUHQVHWXOWV
 7DEOH)LOOR &RPSUHQVHWXOWV 5HVXOWV
 7DEOH)LOOR &RPSUHQVHWXOWV 5HVXOWV
 7DEOH)LOOR &RPSUHQVHWXOWV 5HVXOWV
 7DEOH)LOOR &RPSUHQVHWXOWV 5HVXOWV
 7DEOH /DPLQD B KRUUVH %JWK 5HVXOWV
 7DEOH , QK3HDDUQ 6HWJHGXOWKV
 7DEOH , QK3HDDUQ 6HWJHGXOWKV
 7DEOH 2SHQ RROH6 7H5HQLXOWKV
 7DEOH 2SHQ +RVOHL &RPSUHQVHWXOWV 5HVXOWV
 7DEOH , QWHUHQDPLQD H QJHWKV DQG &XWKHSH %XOWV 6WUHQJ
 7DEOH &RPSUH, P\$IDFQ \$IWHUHQJWK 5HVXOWV
 7DEOH &X7KLG BQHVV 5HVXOWV

/LVW RI)LJXUHV

)LJXUH DQSH 7\SHU, R UH
)LJXUH 6XPPDU\ RH DQWJ B Q GWRKL Q LPXP VK FR B SUDHUVSH FWR LWH
 (TXLYDHO HQ PLWV
)LJXUH 6XPPDU\ RI 8R7GRB DQV DQG (TXLYDHOHQFH OLP
)LJXUH :DUS &RPSUHQVHWXOWV DQG (TXLYDHOHQFH OLP
)LJXUH :DUS 7HQV DQV XPHV DQG (TXLYDHOHQFH OLP
)LJXUH)LOO &RPSUHQVHWXOWV (TXLYDHOHQFH OLP
)LJXUH)LOO 7HQV DQV XPHV DQG (TXLYDHOHQFH OLP
)LJXUH /DPLQD 6KRUUVH %JWK 5HVXOWV
)LJXUH , Q3ODQH 6HDDUQ (TXLYDHOHQFH OLP
)LJXUH 2SHQ +RVOHL &RPSUHQVHWXOWV 5HVXOWV
)LJXUH 2SHQ +RVOHL &RPSUHQVHWXOWV 5HVXOWV
)LJXUH , QWHUHQDPLQD H QJHWKV DQG &XWKHSH %XOWV 6WUHQJ
 (TXLYDHO HQ PLWV
)LJXUH &RPSUH, P\$IDFQ \$IWHUHQJWK 5HVXOWV
)LJXUH &37 PHDQV G HUVW DQV DQG QRPLQDO YDOX
)LJXUH 3UR EIDFIEHLWR IR) DLOXUHV

, QWURGXFWLRQ

7KLV UHSRUW FRQVWLWXV WKH WRTXNDXOIRVFRUO\ \$GYDQFHG &RPSRVLWHV *URXS 070 5: &). 3: \$6)DEULXUFDFFOH FRPSDUHG WFDWFKDROUJLFDWLRQ SDQHOO+SERGXFFHGOXVLRQV VDPH PDWHULDO 7KHQDWPILQDWHQGLDODS/HRISHUQ\JBOUWDDKWH ZLWK)\$\$ RYHUVLJKVSHFKDQX3KR)S\$FW 1X4P BQG 030VR: ,PHHW WKH UHTXLUHPHQW 03RQW/DQGLGGLQSHUSDW63J 3URKHHGXUHW SDQHOO WHVW VSHFLPHQV DQG WHVW KHVY\$\$DQG WKHEHHO WHVWLQJ KDWVHGGCEZWKQH)\$\$

7KH PDWHULDO ZDV* SODRFXWHDGOV6S H&LILFDWIRQLS&*RQ , 5 GDWHG -DQXDU\ HQ\$Q1 &STO3L PDW HULFD 106SHFLILFDW EHHQ FUHDWHG 106 SHFLRQDWDLLRQ/ QHPLWVHGVKDRP DUKH TXDOLILFDWLRQGDMDGMHOLQHV LQ V\$5WLRQDQRGI &27)\$\$ 9ROXPH 5HY * VHFWRQ

7KH PHFKDQLFDO WHVWV GQE\ ZD& DMUWRKHLP DXODFD 02MO 7KH FRPSDULVRQV ZHUH SHQJIRUP &G+DFFRUGHFKLHRQRGLILHG FRHILFLHQW RI YDUFRPSDRU VRRGW8DV DVFZHUHQDQRQZLLQK VHFWRQ RI &0+WHV'W'GDWD ZDV DRWHDXDYDDBQF\IRU FRPSDULVRQ

7KH RULJLQDWRXQGDMD 0DLVQ3X0ZLVK&)DWD 0+ &XUH &\FOH 9DOXH 2QO\ SGLILFDWLRQ WHEULSDWHGVLQHDFFRDGD ZLWK 6ROYD\ IRUP&BES\$GVDVHGRXSLSDWERQV\$&SHFLI 5HYLVLRQ (30+'FKHHFXFDYDHOHQF\ GHGVDQZD07\$XEOLVK &) 'DWD 0 &XUH &\RQHO9DOXHVSGL' 7KHVZHHVM \$DEULFDW LQ DFFRUGDQFH ZLW\$H\$&FLSDRWRQV\$&*3LRQ (30HYFLXUH F\FOH

(QJLQHHULQJ EDVLSYRUWXHG/ LZHU & \$03 5HSRUW 11 & 3 53 ZKLFK GHWDQGDWKH DQV PHWKRGRORJDXVMGYDQXHFVDSXZHDV SURYLGLQJ WKHQGSDVLDQGLYDQXHWFRPSRPHWKH WHVW UH IRU WKH RULJLQDWRXQ SDQHOO

7KH 1&\$03 VKDUHG PDWGHULD DSD/HRISHQWDRSHUFDVGHUWLDQRIS FRPPRQ XVHIXOQHVV WIRDDIRGSDIFDIQSURMFWKWHVGBRZHPB\Q IXOILOO DOO WKH GSHGVIIRF SURSRUWMLV BQFLQBWH DUFK DQG ORDGLQJ VLWXLGDRQSURMDFWLVGDLGGLWDRQDQXLVVWL

\$LUFUDIW FRPSDQLHV VKRXOG QRW SRHW WZHVGRKXDV SXSEFLM 1&\$03 ODWHULDO 6SHFLILFDWLRQ 1KDV DGLHTXLLRQHPHQWV V DUH OLVWHG LQ LVVFBQMSURHJ SRJRXPHSMFL3&FDWILRQU ILEHU DQG RWKHU UZ PDLRQVLDQGV\$&FLZKFDKQWLSROVFXHVOVW\FR

RQ WKH Udz PDWHULDO PDDOQEDQXZDFW XGL SURRFAW...
 companies and certifying agencies should assume that the material property data
 published in this report is not applicable when the material is not procured to NCAMP
 Material Specification NMS 451/7 106 LV D IUHH SXEOLFO\ DYDLODE
 Sursulhwdu\ dhurvSDFH LQGxVWU\ PDWHULDO VSHFLILFD

7KH XVH RI 1 & \$03 PDWHULDO SHHG IS ED VKLRUQ WR RHVPO RMW UL D
 VWUXFWXUDO SHUIRUPDIQFHV KRXVHU ED GD E Q LHYDOO XLDQVROU P
 SHUIRUPDQFH DQG TXDXOLVORMQ ED R GVE BHW RO SH USRWPKL D VHU
 TXDOLW\ FRQWUROU SHUWRVGLSH HTRULDDOMQVW DGG LSLURQLFLS
 PDWHULDO FKDQJH P D G D JHFRIQQW FDFVQLV VWDWLRQW B B O SDQ
 FRQGXFwlQJ UHJXODU VXSSOLHU DXGLWV

7KH DSSOLFDELOLWY & \$03 DD FWHULDOORS B B SHHWWD GDWDD RZDE
 DQG VSHFLILFDWLRQHVGPRQV FVHHHEVDFOVH FDDVWVFRP DDQLHV
 FHUWLI\ LQJ DJHQFLHV V QRS OBL DE V Q PW \UZHVM GRUY HUP S O LSHG
 UHODWHG WR WKHXOV SURISW KW \ PDDWDELOPHW B Q GDOS B OIR F DV

6\PEROV DQG \$EEUHYLDWLRQV

7HVW 3URSHUW\	\$EEUHYLDWLRQ
:DUS &RPSUHVV L RQ	:&
:DUS 7HQVLRQ	:7 5P00ph `À 0G WX",à`2U

7\SH , DQG 7\SH , , (UURUV

	<i>Materials are equal</i>	<i>Materials are not equal</i>
<i>Conclude materials are equal</i>	<i>Correct Decision</i>	<i>Type II error</i>
<i>Conclude materials are not equal</i>	<i>Type I error</i>	<i>Correct Decision</i>

)LJXUH 7\SH , DQG 7\SH , , HUURUV

\$V LOOXVWUDWHGHLQ)LJXUH XU SRVWLZROFRXUMFRVFRQFOX
 DQG WZR HUURQRXV FRQFOXVLRQV 7KHVZ\SHR,QDQFRW
 ,, HUURUV WR GLVWLSUREDELOLWZRZHPDNRQLDWSBFLILHG
 SDUDPHWHU BDOOHZGLDHSWKHW\SHO\,FRUPSRXUHVQRUFRQWU
 7KHWHUP μ VXILFLHQWQH σ QDYLRXOXYSLLQJURD\$KSRHDFVH
 WHUPLQRORJ\ WKHSURPESXELOGLWHRHWWKDWLW\WLPSWQBQR
 QXOO K\SRWKHVLV LV OHVV WKDQ .

)RU HTXLYDOHQF\ WHLWHLQDWRHFRPSRZKLFK VFRWUDHW SRQGV
 FRQILGHQFH OHYHODRIV WKDKLVIPZH DQGM DW WKKH VQXRO EDWH
 DUH QRW HTXLYDOHQF\ ZLWKUWHVSEEDLWH WKKDWK W KSLURED
 GHFLVLRQ LV QR OHVV WKDQ

&XPXODWLYH (UURU 3UREDELOLW\

(DFK FKDUDFWHU\RVQLFWXGLFKDDV7HQQLRQDQWU6KHJDUKPRIGXO
 LV WHVWHG VHSLSUREDELOLWHRWVHWKSHV,DFHUURU DOO WH
 PDQ\ GLIIHUHQW WHVRODUHLQHOHRPDKULDOSWREBEZOLWV
 W\SH , HUURU WKKHSLURJEBEHORW\PRUMHDLQXURHWIHOVWFD
 PXFK KLJKHU

,I ZH DVVXPH WKHWZRGHQWHLFLDDO VZHDVSKRAEZRE LACHLVVVRWV
 HUURU IRU WKFRVZLRQWGLVW í)RU IRXUWHLVWHVWR í
)RU WHVWV WWRH SURVSDHEJGURUWHVWVWRULV í

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1&3 53

5HY 1 &

7KLV LV FRQYH\WPH SWUSO\LQJ E\

&9 LV XVHG WR FRPLXWH DWFQGDUG GHYLDWLRQ 6

$$S \quad CV \quad \bar{X}$$

7R FRPSXWH WKH SRRLDGLRQ EDV DUGGRQH WKH PRGLLHG

$$S_p \sqrt{\frac{\sum_{i=1}^k n_i CV_i \bar{X}_i}{\sum_{i=1}^k n_i}}$$

(TXDWLRQ

7KH \$ EDVLV DQG %X EDVILUVWKH DNV XP SWHRSQ&R IPM WKH RGDW H
FRPSXWHGDELQHSOZLWK 6

:KHQ WKH EDVLV YDOXH V KDYH EHHQ VH

(TXLYDOHQF\ 7HVW 5HVXOWV

7KHUH ZHUH D WRH... WR WKH UHFRPPHQGDWLRQ... ZLWK LQVXILFLHQW... \$OO WHVWV ZHZLW\$HQQR.UOHCHO RI

7KH UHVXOWV RI WKH... &9 μ3DVV ZLWK ORG... FRHIILFLHQW RI YDU... SDQHOB DQG SURFH... VSHFLPHQV IRU PRGXO... RI VSHFLPHQV WK... LQGLFDWLRQ \$ V... LQ 7DEOH

)DLOXUHV LQDT... E\ WDNLQJ WKH UDO... IRU WKDW YDOXH D7... IDLO

'HVFULSWLRQ	ORGXOXV	6WUHQJWK
0LOG)DLOXUH	IDLO "	IDLO "
0LOG WR ORGHUDWH)DLOXUH	IDLO "	IDLO "
ORGHUDWH)DLOXUH	" IDLO	" IDLO
ORGHUDWH WR 6HYHUH)DLOXUH	IDLO XUH	IDLO "
6HYHUH)DLOXUH	IDLO "	IDLO
([WUHPH)DLOXUH	IDLO	IDLO

7DEOH)DLOHG 5HVXOWV 6FDOH

0DUFK

3&3 5 5HY 1 &

(TXLYDOHQF\ 7HVW 5HVXOWV IRU 6ROYDM *JRXPSHUO\&\$QYDQFHGH&RPF
ZLWK 070 &) 5: . 3: \$6)DEULF 0+ &XUH &\FOH

7BD@(0

1RUPPHVJHG 6WUHQJWK@C8C.FTE
3HWYy q(de1, DUP, DAgA, <WAUS* & JUF, eHQ'115D' ARQ
DWDTRP Dh&Dp &7' 57' (7' (7:

6WUHQJWK)DLOHG E\ 3DVV

0RGXOXV 3DVV 3DVV

6WUHQJWK 3DVV 3DVV

0RGXOXV 3DVV 3DVV ZLWK
ORG &9

6WUHQJWK)DLOHG E\ 3DVV 3DVV

0RGXOXV 3DVV)DLOHG E\ DLOHG E\

6WUHQJWK 3DVV 3DVV ,QVXIILFLHQW
'DWD

0RGXOXV)DLOHG E\ DLOHG E\)DLOHG E\

2IIVHW 3DVV
6WUHQJWK QVXIILFLHQW
'DWD

6WUDLQ 3DVV
6WUHQJWK

0RGXOXV 3DVV)DLOHG E\

6KRUW %HDP 1R 6WUHQJWK)DLOHG E\ 3DVV ZLWK
ORG &9

2SHQ +ROH <HV &RPSUHVVLQR 6WUHQJWK 3DVV 3DVV ZLWK
ORG &9 ,QVXIILFLHQW
'DWD

2SHQ +ROH <HV 7HQVLRQ 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

,QWHUODPLQDU 1R 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

&XUYHG %HDP 1R 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

&RPSUHVVLQR <HV \$IWHU ,PSDFW 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

&XUH 30\ 1\$ 7KLFNQHV 1\$

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1&3 53

5HY 1 &

:DUS &RPSUHVVLRQ :&

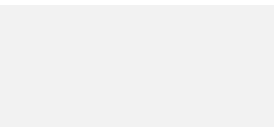
7KH :DUS &RPSUHVVLRQ GDWD E V FQRJ H G7 & 8 \ : W I Q L F U N Q D H O L M J H G
 VWUHQJWK G & W D H S D L V D H G R U F W K W H (7 W F R E Q U L Q R W Q I R U W K H 5 7
 FRQGLWLRQ 7KH : & Q R O X P D G D J W G B D V V H G W T I R L Y E G M Q F W W H
 57' DQG (7: FRQGLWLRQ V U H V X G M V H Z H U H R O R W K S I U (F Y L G W H G H Q J
 GDWD E H F D X V H W K E U F R D W L L R F Q H Z O W B E R Y Q I V W Z K L W K W K H H P R G L
 & 9 U H V X O W V Z H U H P Q W K G L U H V X Q W V I W K B Q G D Q D W L L W W L F V X O
 VKRZQ IRU W K H V W D U H Q J W K G Q W D R L Q W K H L P R G E O M G D

4XDO (TXLY 4XDO (TXLY

'DWD QRUPDOLJHG ZLWK &37
 0HDQ 6WUHQJWK NVL
 6WDQGDUG 'HYLDWLRQ
 &RHIILFLHQW RI 9DULDWLRQ
 0LQLXP
 0D[LXP
 1XPEHU RI 6SHFLPHQV

5(68/76

0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ
 0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ



0DUFK

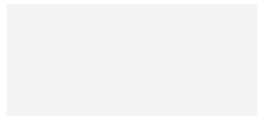
1&3 53

5HY 1 &

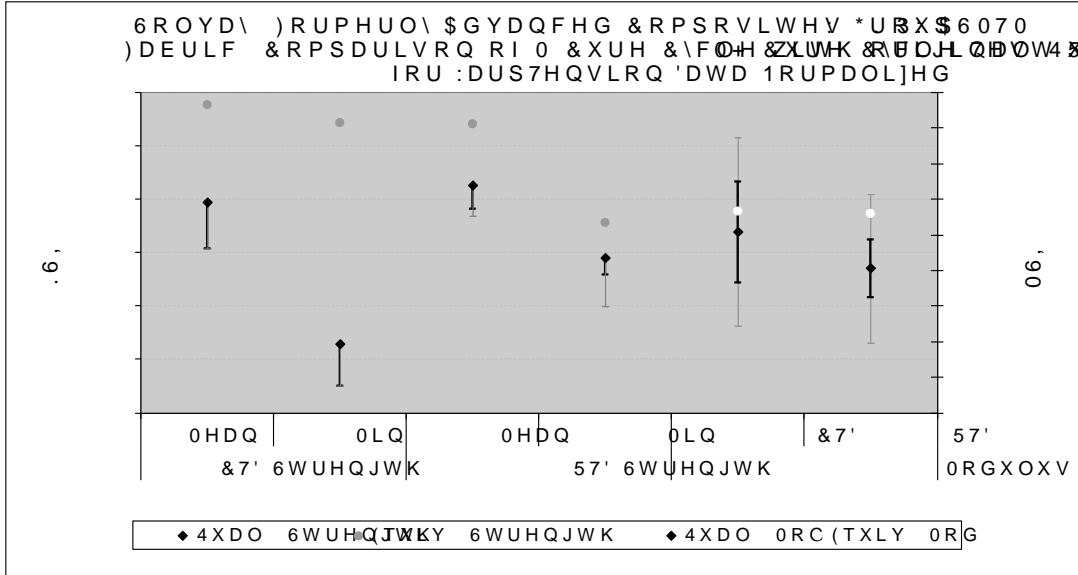
:DUS 7HQVLRQ :7

7KH :DUS 7HQVLRQ GDWD LV QRUPDOLJHG CER UFXDOLJHG GVVW
SDVVHG DOO HTXLYDOHQF\ WOHVW' IRRORUWLRQV DRUPDOLJH
PRGXOXV GDWD LQ WHT5XL'UHQW\KMLRQHG R9WPKHWKRLWR SI
HTXLYDOHQF\ ORGLZHUH &ORUHSXWLVGHWUHQJWKKGDW'D EHF
WKH FRHIILFLHQW RIEYULDVZKRQKZBHQGLMLKQW&WKHVXOWV
ZHUH QR GLIIHUHQWUJRRZQH 6WDXVLVWULFWXDQGDQBOXR
WKH VWUHQJWVORSDWDDQRORUWKKHGDWD LQ 7DEO

4XDO (TXLY 4XDO (TXLY
'DWD QRUPDOLJHG ZLWK &37
0HDQ 6WUHQJWK NVL
6WDQGDUG 'HYLDWLRQ



)LJXUH LOOXVWULRQ HWWWKHQJWKPHDQVDOXQGVPLQGPKKH
 PRGXOXV PHDQV IRBQWKBIPTXCHODIQGDMWLBHSTOHL YDIOHHOFLPLWV
 HTXLYDOHQF\ VDP SOHMUDBH EEBZQZDWKQWGBWTDX DOKHLGBWJH
 OLJKWHU FRORUHGUHWKURBREGLU VHDGU&9IRRPSXWDWLRQV



)LJXUH :DUS 7HQVLRQ RRGXPHDQGVHTXLYDOHQFH OLPL

)LOO &RPSUHVLRQ)&

7KH)LOO &RPSUHVLRQ LQGHDO E\LFXQRIG7&E\WQLFWRDHO\JHG
 VWUHQJWK GDWD SDWWHG IRTUXWYKHO(HQDLQWLRQVFRXQG QRW W
 57' FRQGLWLRQ 7KHIG) & RQRUPSDOJHG DHTXWYDOWHQ RQO\ IRU
 57' FRQGLWLRQ QRW (R:UFWRIGLWLRQVUHVRXGMVHZH&E QRW
 SURYLGHG HQW WKIGDWWDEHFDXVH LQHQDO REIDYBU LDKHLFRHZID
 DERYH ZKLFK PHDQVLMIGD&9 WKNXPORVGHZQWHUORPGLKHUHV
 VKRZQ 6WDWLWLFVWQGDQDQDQZQVRFUGXWHDVQUDQOH
 IRU WKH PRGXOXVDEOW

)LOO &RPSUHVLRQ	57' 6WUHQJWK 4XDO (TXLY	(7' 4XDO	(7: 4XDO (TXLY	4XDO (TXLY
'DWD QRUPDOLJHG ZLWK &37 0HDQ 6WUHQJWK NVL 6WDQGDUG 'HYLDWLRQ &RHILFLHQW RI 9DULDWLRQ 0LQLXP 0DLPXP 1XPEHU RI 6SHFLPHQV				
5(68/76		3\$66	3\$66	
0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ				
0LQLXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ				

7DEOH)LOO &RPSUHVLRQ 6WUHQJWK 5HVX

4XDO (TXLY 4XDO (TXLY 4XDO (TXLY
 'DWD QRUPDOLJHG ZLWK &37
 0H GgT• P# XQRg!7bIFeFi0 @ • TeQ! UFeFi0)@ 0 @•°

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5HY 1 &

7KH)& PRGXOXV GDWYRURQPHQW IDLOHGWKHW HETHKLDYDOH
VDPSOH PHDQ YDOXHH WKH XSDHURDFFHSWDQRH OLPLW

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1&3 53

5HY 1 &

)LOO 7HQVLRQ)7

7KH)LOO 7HQVLRQ HGDWDFXUQBUSPOOMJLGRQPIDOLJHGHVWUH
GDWD SDVVHG HTXLYDQWQWKWHHVWR7KBLWLRQRUPVHDLVHGG
PRGXOXV GDWD GLGHQFWSDVWVHTXUHDORQG LKLRQKWHVWH
WKUHH FDVHV GXH MRDQKHPRGXRVRKJJKHVXRDMLZHUQRV
SURLGHHG IRU WKHHQZ'WKUG(DWDVEUHFDXWHRWKYDDBDWLRQHZD
DERYH ZKLFK PHDQGLWKHDG&QKHHVXOVMQZHIURQRVSHIUV
VKRZQ 7KHUH ZHUSHIFQPHIQMFILEQWKVDTWDVWRUHQJMKUGIVXOV
EH FRQVLGHUHG FRQVEOXVLCG DQDQDWRZQUHVKOMKVDWUHWQJ
LQ 7DEOH DQG IRU WKH PRGXO

0DUFK

1&3 53

5HY 1 &

7KH)7 PRGXOXV GDWIDYBURWQRHGW IDLQFIQWMMK/M HETXFLDYDCHV
VDPSOH PHDQ YDQXRYH WKHVXSSHU DFFHSWVQEFH OLPLW
HTXLYDOHQF\ VDPSDVH PHDQRYDQKH XSSHFUHSWDEWHR YDOXH V

0DUFK

1&3 53

5HY 1 &

)LJXUH LOOXVWUJWDIR @WKUH@KRWK PPIYD@D@G IRLQWKH
TXDOLILFDWDRG WDPHS@FXLYDOHQF\ VDF@DYD@K@FO LPLASOH
DUH VKRZQ DV HUWRH EXD@G@L@W@Z@K@D@R@Q@V@HU FRORUHG HU
DUH IRU WKH PRGLILHG &9 FRPSXWDWLRQV



,Q 30DQH 6KH DU ,36

7KH ,Q 30DQH 6KH DRU B D O D I H G Q R W O B S D V U H G V D O G D W
 HTXLYDOHQF\ WHVWXV G D W D B S P R G H G H T X R V D O K H Q & 7 W H V W
 FRQGLWLRQ EXW Q R R Q W K K H 5 7 H Z R Q G L R V 6 W W D H L Q Q V G D W D D Y D L O
 IRU WKH 0 FXUH F \ F B G L Q W R K Q 8 7 R G L Z H H G Q R W H S / U R Y L G H G I
 2 I I V H W & 7 ' G D W D V H W E R F D I L V H H Q W B E R Y D H L D W K R K Z D
 PHDQV W K D W W K H P R Z H U H Q R & G U I H N X H O X V W U R P K R Z Q U 7 K H U
 Z H U H L Q V X I I L F L H Q M H V , S B F L P H Q W H Q W D W U H H Q J R U K V G D W & 7 '
 FRQGLWLRQ IRU V F R Q V L H G V K O H G V F R R F O H X D Q G H D Q D O D W I L W W H V X O
 V K R Z Q IRU W K H K I D O H G V 6 W W U H Q J W K V W L Q 6 7 D E D L Q G D D Q
 IRU W K H 0 R G X O X V D E D W

,Q 30DQH 6KH DU ,36	2 I I V H W		6 W U D L Q	
	6 W U H Q J W K	5 7 '	5 7 '	4 X D O (T X L Y
'DWD DV PHDVXUHG 0HDQ 6WUHQJWK NVL 6WDQGDUG 'HYLDWLRQ &RHILFLHQW RI 9DULDWLRQ 0LQLPXP 0D[LFP 1XPEHU RI 6SHFLPHQV				
5(68/76	3\$66	3\$66	3\$66	
0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ				
0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ				
02' & 9 5(68/76		3\$66 ZLWK 02'	3\$66 ZLWK 02'	& 9
0RGLLHG & 9 1\$				
0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ				
0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ				

7 D E O H , Q 3 0 D Q H 6 K H D U 6 W U H Q J W K 5 H V X O W V

,Q 30DQH 6KH DU ,36	6 W U H Q J W K		5 7 '	
	4 X D O	(T X L Y	D	O
'DWD DV PHDVXUHG 0HDQ 0RGXOXV 0VL 6WDQGDUG 'HYLDWLRQ &RHILFLHQW RI 9DULDWLRQ 0LQLPXP 0D[LFP 1XPEHU RI 6SHFLPHQV				
5(68/76	3\$66			
3DVVLQJ 5DQJH IRU 0RGXOXV 0HDQ			WR	
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02' & 9 5(68/76	3\$66 ZLWK 02'	& 9		
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HTXLYDOHQF\ VDP SDVH PHDQ RYD\KH X SDFH SW DEO HRYDOXH V
8QGHU WKH DVVXPSO LIRGR & WRH WPKRG WKFSCFXPLDQHLQF\
RI WKH PD[LXP DFFHSWDEOH PHDQ YDOXH
)LJXUH LOOXV\DDQW\KHWKUHV,QU3Q\WRXPHYDQ\XDQGDQIG W
PRGXOXV PHDQV IRU WKH TXDOLILFDWL

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3 ' 2SHQ +ROH &RPSUHVVLRQ 2+&

7KH 2SHQ +ROH &RPSUHVVLRQ 2+& \LQXUHG \$ON W&HON+RO
 &RPSUHVVLRQ QRUP DOW DOW DOW DOW DOW DOW DOW DOW DOW DOW DOW
 (7: FRQGLWLRQV DOW DOW DOW DOW DOW DOW DOW DOW DOW DOW
 PHWKRG WR SDVV IWKFLHQV DOW DOW DOW DOW DOW DOW DOW DOW DOW DOW
 FRQVLGHUHG FRQFOXVLYH DOW DOW DOW DOW DOW DOW DOW DOW DOW DOW
 VKRZQ LQ 7DEOH

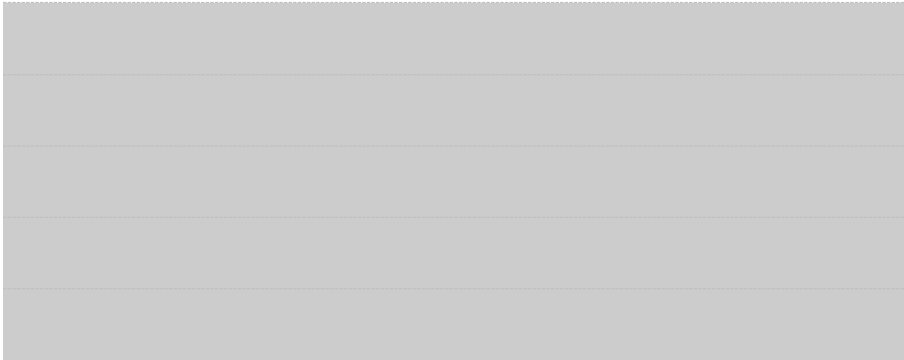
2SHQ +ROH &RPSUHVVLRQ 2+&	(7:	
6WUHQJWK 4XDO (TXLY	4XDO (TXLY	
'DWD QRUPDOLJHG ZLWK &37	,QVXIIIFLHQW 'DWD	
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&RHIIIFLHQW RI 9DULDWLRQ		
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)LJXUH LOOXVWURDWH & RVPISH HZSVILQR QVVWVUGH QJLQKPPHPD Q
YDOXHV IRU WKH TXDODQLG DWKLR BTXD PFKOH QEP LWDVSBH
HTXLYDOHQF\ VDP SOHMURB H EBZQZ DWKQWGB WTXDOKHLERWJH
OLJKWHU FRORUHGU HWKLR BREGLU VHDGU & 9I R R P S X W D W L R Q V



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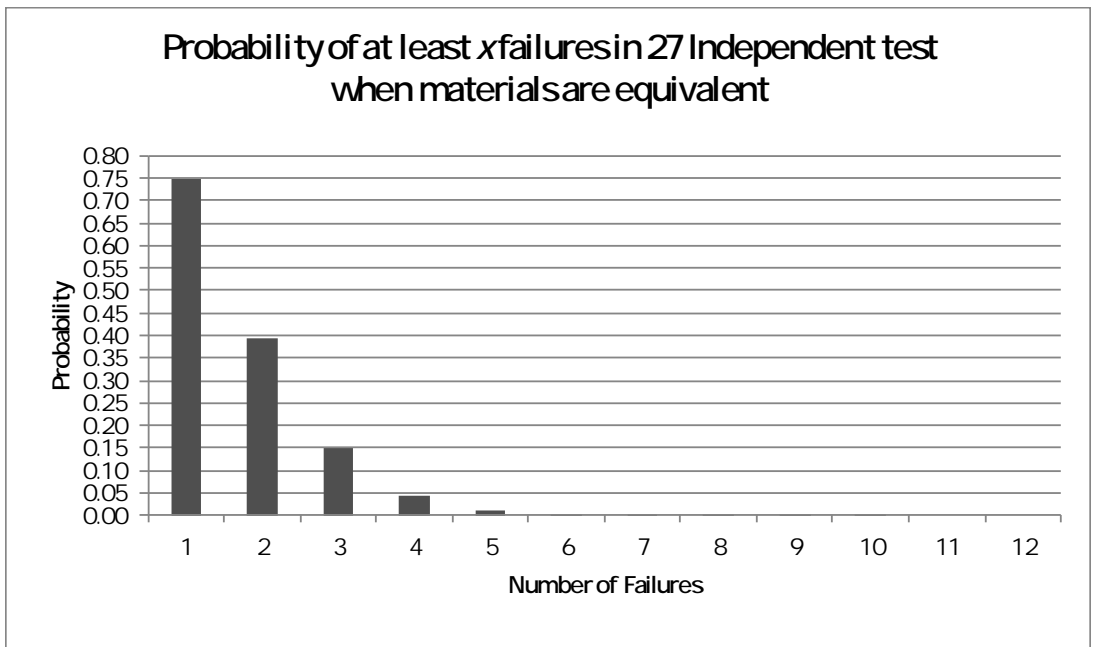
&XUHG 30\ 7KLFNQHV V &37

7KH &XUHG 30\ 7KLFNQHV V G HFDQGEHT XL YD R HQWH DFFVRKUGLVQ JR I
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3UREDELOLW\ RI)DLOXUHV

,I WKH HTXLYDOHQFRV DPBDWFUDLPHOIZWWRKVFKGDHODWVFDUQWWR
 RULJLQDO TXDODQLDQGLRQOPDMMWLVZRHDHDLQVGHVQWV
 FKDQFH RI KDRULQRQHQLDLOXUHVVXUVH LOOXVWUDWVWKH
 RI JHWLQJ RQH RWZRRUHU IDROXUDDOXHVVRIHWEQGRHS HQGH
 WHVWV ,I WKH WZRHPTXLYDODHODWVZVWKV SURIEDERLOLWDLOXUH
 LV OHVV WKDQ 7KLVHPHDQMVWDDWFR&ODG/ERFRVQVTLXGHDH
 ZLWK D OHYHO RI WFRPHZHQWHIRXUVRURXVCRHSHQSHQW
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