

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 6SRWHQW \$ 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\ 7KLFNQHV &37

6XPPDU\ RI 5HVXOWV

7KH DVVXPSWLRQ RI ,QGHSHQGHHQH

)DLOXUHV

3DVV 5DWH

3UREDELOLW\ RI)DLOXUHV

5HIHUHQFH

/LVW RI 7DEOHV

7DEOH 7HWW \$EUBHHDQV
 7DEOH (QYLURQH VMDOV & \$EEUHYLDWLRQV
 7DEOH 2QH VLG HFGWR B O H B D QFLP LDV VYDQ XHVP SOH PHDQ
 7DEOH 2QH VLG HFGWR B O H B D QFLP LDV VYDQ XHVP SOH PHDQ
 7DEOH)DLOXHG W V 6FDOH
 7DEOH 6XPPDUORQ FT XLYWDV 5HVXOWV
 7DEOH :DUSV & RPS UH V H N Q D W W V
 7DEOH :DUSV & RPS UH R G X Q W V
 7DEOH :DUSQ 7HQV H Q J X K W V
 7DEOH :DUSQ 7HQV H Q J X K W V
 7DEOH)LOOR & RPS UH Q J W K 5HVXOWV
 7DEOH)LOOR & RPS UH Q J W K 5HVXOWV
 7DEOH)LOOR 6HQV H Q J X K W V
 7DEOH)LOOR 7HQV H Q J X K W V
 7DEOH /DPLQD B KRUUW %JWK 5HVXOWV
 7DEOH , QK3HDDUQ 6HW 3UH Q J W K V
 7DEOH , QK3HDDUQ 6HW 3UH Q J W K V
 7DEOH 2SHQ RROH 6HQV H Q J X K W V
 7DEOH 2SHQ +RVOHL & RPS UH Q J W K 5HVXOWV
 7DEOH , QWHU & RPS UH Q J W K V DQG & XWKH 3H %XOW V6WUH Q J
 7DEOH & RPSUH, P\$IDFQ \$I W U H Q J W K 5HVXOWV
 7DEOH & X7KLG B O H V V 5HVXOWV

/LVW RI)LJXUHV

)LJXUH DQGH 7\SHU, R UH
)LJXUH 6XPPDU\ RH DQWU B Q G W P K L P X P V K F R B S U H V H S H F W R L W H
 (TXLYDHO HQ PLWV
)LJXUH 6XPPDU\ RI 37GR B D Q V D Q G G (TXLYDHOHQFH OLP
)LJXUH :DUS & RPS UH Q J W V E R Q L P X P V D Q G (TXLYDHOHQFH OLP
)LJXUH :DUS 7HQV H Q J X P H V D Q G G (TXLYDHOHQFH OLP
)LJXUH)LOO & RPS UH V Q J L R X P F H D Q G G (TXLYDHOHQFH OLP
)LJXUH)LOO 7HQV H Q J X P H V D Q G G (TXLYDHOHQFH OLP
)LJXUH /DPLQD 6KRUUW % F B D Q W U P L Q L P X P W V
)LJXUH , Q 3ODQH 6HQV H Q J X P H V D Q G G (TXLYDHOHQFH OLP
)LJXUH 2SHQ +RVOHL & RPS UH Q J W K V D Q G G (TXLYDHOHQFH OLP
)LJXUH 2SHQ +RVOHL & RPS UH Q J W K V D Q G G (TXLYDHOHQFH OLP
)LJXUH , QWHU & RPS UH Q J W K V D Q G G (TXLYDHOHQFH OLP
 (TXLYDHO HQ PLWV
)LJXUH & RPSUH, P\$IDFQ \$I W U H Q J W K V P L Q L P X P W V
)LJXUH & 37 PHDQV G H U W R D Q G G D Q G Q R P L Q D O Y D O X
)LJXUH 3UR E I X P I E C H L W R I R) D L O X U H V

,QWURGXFWRQ

7KLV UHSRUW FRQVWDHQW WKH WRTXNDXOIRVFRUO\ \$GYDQFHG &RPSRVLWHV *URXS 070 5: &). 3: \$6)DEULXUFDFFOH FRPSDUHG WFDWFKDROUJLFDWLRQ SDQHOO+SERGXFFHGOXVLRQJ VDPH PDWHULDO 7KHQDWPILQDWHQJL DODS/HRISHUQ\JBOUWDDKWH ZLWK)\$\$ RYHUVLJKVSHFKDQX3KR)SIFW 1X4P BQG 030VR: ,PHHW WKH UHTXLUHPHQW 03RQW/DQGLGLQSHUSDW63J 3URKHHGXUHW SDQHOO WHVW VSHFLPHQV DQG WHVW KHVY\$\$ DQG WKHEHHO WHVWLQJ KDWVHGHQEZWKQH)\$\$

7KH PDWHULDO ZDV* SODRFXWHDGOV6S H&LILFDWIRQLS&*RQ , 5 GDWHG -DQXDU\ HQ\$Q1 &STO3 PDW HULFD 106SHFLILFDW EHHQ FUHDWHG 106 SHFLRQDWDLLRQ/ QHPLWVHGVKDRP DUKH TXDOLILFDWLRQJDXMDGHQV QHV LQ V\$5WLRQDQRGI &27)\$\$ 9ROXP 5HY * VHFWRQ

7KH PHFKDQLFDO WHVWV GQE\ ZD& DMUWRKHLP DXDFLO2MO 7KH FRPSDULVRQV ZHUH SHQJIRUP &G+DFFRUGHFKLHRQRGLILHG FRHILFLHQW RI YDUFRPSDULVRQGW8DV DVFZHUHQDQRQZLLQK VHFWRQ RI &0+WHV'W'GDWD ZDV DRWHDXDYDDBQF\IRU FRPSDULVRQ

7KH RULJLQDWRXQGDMD 3DLQ3X0ZOLVK&)DWD 0+ &XUH &\FOH 9DOXH 2QO\ SGLILFDWLRQ WHEULSDWHGVLQHUFRDGD ZLWK 6ROYD\ IRUP&BES\$GVDVHGRXSLSDWERQV\$&SHFLI 5HYLVLRQ (30+'FKHHTXFLYDHOHQF\ GHGDQZD07\$XEOLVK &) 'DWD 0 &XUH &\RQD9DOXHVSGL' 7KHVZHVUM \$DEULFDW LQ DFFRUGDQFH ZLW\$H\$&FLSDRWRQV\$&*3LRQ (35HYFLXUH F\FOH

(QJLQHHULQJ EDVLSYRDUWKHG/ LZHU & \$03 5HSRUW 11 & 3 53 ZKLFK GHWDQGDWKH DQV PHWKRGRORJDXVMGYDQXHFVDSXZHV DV SURYLGLQJ WKHQGSDVLDQGLYDQVHWFRPSRPHWKH WHVW UH IRU WKH RULJLQDWRXQ SDQHOO

7KH 1&\$03 VKDUHG PDWGHULD DSD/HRISHUQWDRSHUFDVGHUWLDQRIS FRPPRQ XVHIXOQHVV WIRDDIRGSDIDFBIQSURM HFKVHGDRZHPB\ Q IXOILOO DOO WKH GSHGVIIRF SURSIRUMLV BQFLQBWH DUFK DQG ORDGLQJ VLWYLDVDRQSURMDFWLVQGLGGLWDRQDIXLVVWL

\$LUFUDIW FRPSDQLHV VKRXOG QRW SRHWWZHVGKDRXDV 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 DQGGHQZDFW XGLSURRFAWSPMQW D
 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 LQG XVWU\ PDWHULDO VSHFLILFD

7KH XVH RI 1 & \$03 PDWHULDO SHQGIS EDWLDUQWRHIVPQRMMWL D
 VWUXFWXUDO SHUIRUPDQFH DQG TXDOLWV RMQDORRQV BHWROSHUSI RWPKLVHU
 SHUIRUPDQFH DQG TXDOLWV RMQDORRQV BHWROSHUSI RWPKLVHU
 TXDOLW\ FRQWURO VSHUWRG LSH HTRULDDOMQVWDGGLSLRQLFLS
 PDWHULDO FKDQJH PLGDJHFRHQWDFVQLVWVWVLRQV BRO SDQ
 FRQGXFWLQJ UHJXODU VXSSOLHU DXGLWV

7KH DSSOLFDELOLWY \$03 PDWHULDOORS B BSHHWDCDDORZDE
 DQG VSHFLILFDWLRQV GPRQV FVHHHEDFDLWVFDVWVFRPDDQLHV
 FHUWLI\LQJ DJHQFLHV 1 & \$03 B BSHHWDCDDORZDE
 UHODWHG WR WKHXVSIURISWUW\PDWHULDOV B BSHHWDCDDORZDE

6\PEROV DQG \$EEUHYLDWLRQV

| | |
|--------------------------------|---------------|
| 7HVW 3URSHUW\ | \$EEUHYLDWLRQ |
| :DUS &RPSUHVVLRQ | :& |
| :DUS 7HQVLRQ | :7 |
|)LOO &RPSUHVVLRQ |)& |
|)LOO 7HQVLRQ |)7 |
| ,Q 3ODQH 6KH DU | ,36 |
| 6KRUW %HDP 6WUHQJWK | 6%6 |
| 2SHQ +ROH 7HQVLRQ | 2+7 |
| 2SHQ +ROH &RPSUHVVLRQ | 2+& |
| ,QWHUODPLQDU 7HQVLRQ | ,/7 |
| &XUYHG %HDP 6WUHQJWK | &%6 |
| &RPSUHVVLRQ \$IWHU ,PSDFW &\$, | |
| &XUHG 3O\ 7KLFNQHV | &37 |

7DEOH 7HVW 3URSHUW\ \$EEUHYLDWLRQV

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 LOOXVWUDWHG HLUH)LJXUH XU SRV VLZRO FRPXUMFRVP FRQFOX
 DQG WZR HUURQRXV FRQFOXVLRQV 7KHV ZR\SHR, QDQGR QR
 ,, HUURUV WR GLVWLSUREDELOLW RZ HPDNRQLD WSIFLILHG
 SDUDPHWHU BDOOHZGLDHSWKH W\SHO\, FRPUSXUHV QRWF RQWU
 7KH WHUP μ VXIILFLHQWKH SQRJLIRXOXYS DLQD PUDSHKSPHDFQVH
 WHUPLQRORJ\ WKH SURPESXELHQG W\HRHWWKDWLW\WKLPFSWQ&Q R
 QXOO K\SRWKHVLV LV OHVV WKDQ .

)RU HTXLYDOHQF\ W\HWWHLQDWRHFRPSRZK LFK VFRW UHW SRQGV
 FRQILGHQFH OHYHODRIV WKLVLIPZH DQGM DW WKKH VQXRO EDWH
 DUH QRW HTXLYDOHQF\ ZLSDKUWHV S&EDLWH WKKDWK W KSLRE D
 GHFLVLRQ LV QR OHVV WKDQ

&XPXODWLYH (UURU 3UREDELOLW\

(DFK FKDUDFWHU\LRQVILW XGLFKD DV7HQQLRQDQW U6KHJDUKPRIGXO
 LV WHVWHG VHSLSUREDELOLWHRWVHWKSHV,DFHURU DOO WH
 PDQ\ GLIIHUHQW WHV\Q DUHLQHOHRPDKULDOSWHREBEZOLWV
 W\SH , HUURU WKKH SLQJE B&HORW\PRUMHDLQXURHWHQWV FDC
 PXFK KLJKHU

,I ZH DVVXPH WKH WHZ R GFDQWHLLFLDDO VZHDVSK RAEZRE MCHLWV VR W W
 HUURU IRU WKFRVEZLRQWGLVW í)RU IRXUWW\H\WVHW WR í
)RU WHVWV WWKHI SURPESDEJLQURURHUWRQVWRULV í

0DUFK

3&3 5

5HY 1 &

0DUFK

1&3 53

5HY 1 &

0DUFK

1&3 53

5HY 1 &

7KLV LV FRQYH\WPH SWUSO\LQJ E\

&9 LV XVHG WR FRPLXWGH 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
FRPSXWHGDELQHSZLWK 6

:KHQ WKH EDVLV YDOXH V KDYH EHHQ VH

(TXLYDOHQF\ 7HVW 5HVXOWV

7KHUH ZHUH D WRH... WR WKH UHFRPPHQGDWLRQ... ZLWK LQVXILFLHQW... \$OO WHVWV ZHZLW\$HDQR.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
3HWYq(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\

6KRUIW %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 7HQVLRQ 6WUHQJWK 3DVV ,QVXIILFLHQW
'DWD

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

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

&XUHG 30\ 1\$ 7KLFNQHV 1\$

0DUFK

1&3 53

5HY 1 &

:DUS &RPSUHVVLRQ :&

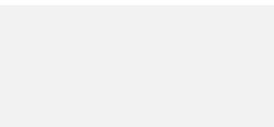
7KH :DUS &RPSUHVVLRQ GDWD E V FQRJ H G7 8 9 \ : W I Q L F U N Q D H O L M J H G
 VWUHQJWK G R W D H S D L V D H G R U F W K W H (7 W F R E Q U L Q R W Q I R U W K H 5 7
 FRQGLWLRQ 7KH : R Q R O X P D G D J W G B D V V H G W T I R L Y E G M Q F W W H
 57' DQG (7: FRQGLWLRQ V U H V X G M V H Z H U H R 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 R 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
 0LQLPXP
 0D[LXP
 1XPEHU RI 6SHFLPHQV

5(68/76

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



0DUFK

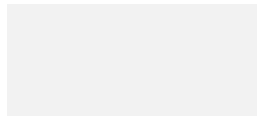
1&3 53

5HY 1 &

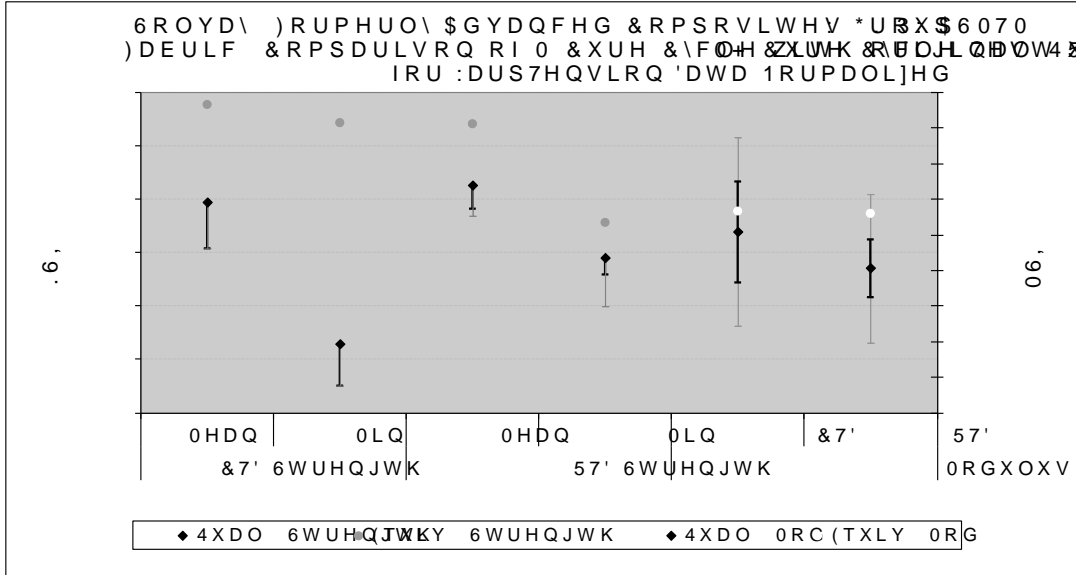
:DUS 7HQVLRQ :7

7KH :DUS 7HQVLRQ GDWD LV QRUPDOLJHG CER UFXDOLJHG GVVW
SDVVHG DOO HTXLYDOHQF\ WQHVS' IRRORUWLRQV DRUPDOLJH
PRGXOXV GDWD LQ WHT5XL'UHQW\KMLRQG R9WPKHWKRLWR SI
HTXLYDOHQF\ ORGLZHUH &ORUHS XE WLVGHWUHQJ WKK E &W'D EHF
WKH FRHIILFLHQW RIEYULDZKR EKZ BHPDGLMLKQW &W KH V XOW
ZHUH QR GLIIHUHQW JURRZKH 6WDXVLVWULFWXDWG DQ BOKR
WKH VWUHQJWK B DWDD QORONOXKHGDWD LQ 7DEO

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



)LJXUH LOOXVWULRQ HWWWKHQJWKPHDQVDOXQGVPLQGPKKH
 PRGXOXV PHDQV IRBQWKBIPTXCHODIQGDMWLBHSTOHL YDIOH OELPLWV
 HTXLYDOHQF\ VDP SOHMUDBH EEBZQZDWKQWGBWTDX DOKHL OBRWJH
 OLJKWHU FRORUHGUWUHRBREGLU VHDGU&9IRRPSXWDWLRQV



)LJXUH :DUS 7HQVLRQ RRGXPHDQGVHTXLYDOHQFH OLPL

)LOO &RPSUHVLRQ)&

7KH)LOO &RPSUHVVRBQLGHDV\LFXQRIG7&B\WQLFWRDHOV\JHG
 VWUHQJWK GDWD SDWVHG IRTUXWYKHO(HQDLQWLRQVFRXQQRW W
 57' FRQGLWLRQ 7KHIG) & RQRUPSDVGDHGTXWYDOWHQ RQO\ IRU
 57' FRQGLWLRQ QRW (R:UFWRIGLWLRQVUHVRGMVHZH&B QRW
 SURYLGHG HQWVWKIGDWD EHFDXVH LQHQDQD RFDYBVLVWVHLFRHZI
 DERYH ZKLFK PHDQVLMIGD&B WKNXPORVGHZQW HURR QLKHHUHV
 VKRZQ 6WDWLWVLFVQVQGDQDQVZQVLRUGXWHDVQVHDEOH
 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 @• °

0DUFK

1&3 53

5HY 1 &

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

0DUFK

1&3 53

5HY 1 &

)LOO 7HQVLRQ)7

7KH)LOO 7HQVLRQ HGDWDFXUQBUSPOOMJLGRQPIDOLJHGHVWUH
GDWD SDVVHG HTXLYDQWQWKWHHVWR7KBLWLRQRUPVHDLVHGG
PRGXOXV GDWD GLGHQFWSDVWVHTXWYDORQG LWKLRQKWHVWH
WCUHH FDVHV GXH MRDQKHPRGXRVRKJJKHVXRGMLZHCJQRV
SURYLGHG IRU WKHH&7'WKUG(DWDVEUHFDXWHRWKYDGRBWLRLQHZD
DERYH ZKLFK PHDQG LWKHGV&0KUHPRXOVMQZHIURQRVBIUHV
VKRZQ 7KHUH ZHUSHIFQPHIQMFILEQWKH DWDVWRUHQJMKUGVXOV
EH FRQVLGHUHG FRVEXVLCYGDQDOWLRZQUHVKOMKH DWHUHQJ
LQ 7DEOH DQG IRU WKH PRGXO

0DUFK

1&3 53

5HY 1 &

7KH)7 PRGXOXV GDWIDYBURWQRHGW IDLQFIQWMMKMW HETXFLDYDCHV
VDPSOH PHDQ YDQXRYH WKHVXSSHU DFFHSWVQEFH OLPLW
HTXLYDOHQF\ VDPSDVH PHDQRYDQKH XSSHFUHSDWDEWHR YDOXH V

0DUFK

1&3 53

5HY 1 &

)LJXUH LOOXVWUJZWDIY @WKUHQKRWK PPIYDWDQV IRLQWKH
TXDOLILFDWDRQ WDPHS@FXLYDOHQF\ VDFXOYDOKHFO LPLPSOH
DUH VKRZQ DV HUWRH EXDQYGLWZK HDJRQVHU FRORUHG HU
DUH IRU WKH PRGLILHG &9 FRPSXWDWLRQV



,Q 30DQH 6KH DU ,36

7KH ,Q 30DQH 6KH DRU B D O I D I H G Q R W O B S D V U H Q G V D O G D W
 HTXLY DOHQF \ WHV WXV G H 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 I 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 I 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 M W & 7 '
 FRQGLWLRQ IRU V F R I Q V L H G V K O H G V F R R Q 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 WKH K I D O H G V 6 W W U H Q Q J W K V W L Q 6 7 D E D L Q G D D Q
 IRU WKH 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 ,QVXIILFLHQW 'DWD 0HDQ 6WUHQJWK NVL 6WDQGDUG 'HYLDWLRQ &RHIIILFLHQW 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 |
| 0RGLILHG & 9 1\$ | | | | |
| 0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ | | | | |
| 0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0LQ | | | | |

7 D E O H , Q K 3 O D Q H 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 ' | |
|--|-----------------|-----|-------|-----|
| | 0 R G X O X V | 4 X | D | O |
| 'DWD DV PHDVXUHG 0HDQ 0RGXOXV 0V 6WDQGDUG 'HYLDWLRQ &RHIIILFLHQW RI 9DULDWLRQ 0LQLPXP 0D[LFP 1XPEHU RI 6SHFLPHQV | | | | |
| 5(68/76 | 3\$66 | | | |
| 3DVVLQJ 5DQJH IRU 0RGXOXV 0HDQ | | | WR | |
| 6WXGHQW V W V W D W L V W L F | | | | |
| S Y D O X H R I 6 W X G H Q W V W V W D W L V W L F | | | | |
| 02' & 9 5(68/76 | 3\$66 ZLWK 02' | | | & 9 |
| 0RGLILHG & 9 | | | | |
| 3DVVLQJ 5DQJH IRU 0RGXOXV 0HDQ | | | WR | |
| 0RGLILHG & 9 6WXGHQW V W V W D W L V W L F | | | | |
| S Y D O X H R I 6 W X G H Q W V W V W D W L V W L F | | | | |

u ,AÀ

Äu Ä T aT' Xf 6

0DUFK

1&3 53

5HY 1 &

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\WRXPH\DDQXDQGDQIG W
PRGXOXV PHDQV IRU WKH TXDOLILFDWL

0DUFK

1&3 53

5HY 1 &

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 DOW
 PHWKRG WR SDVV IWKFLHQV DOW DOW DOW DOW DOW DOW DOW DOW DOW
 FRQVLGHUHG FRQFOXV DOW DOW DOW DOW DOW DOW DOW DOW DOW DOW
 VKRZQ LQ 7DEOH

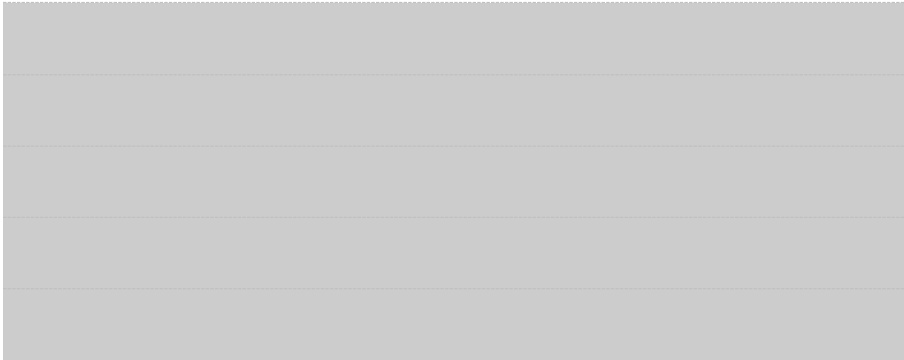
| | | |
|---------------------------------------|-------------------|----------------------|
| 2SHQ +ROH &RPSUHVVLRQ 2+& | (7: | |
| 6WUHQJWK 4XDO (TXLY | 4XDO (TXLY | |
| 'DWD QRUPDOLJHG ZLWK &37 | ,QVXIIIFLHQW 'DWD | |
| 0HDQ 6WUHQJWK NVL | | |
| 6WDQGDUG 'HYLDWLRQ | | |
| &RHIIIFLHQW RI 9DULDWLRQ | | |
| 0LQLPXP | | |
| 0D[LFXP | | |
| 1XPEHU RI 6SHFLPHQV | | |
| 5(68/76 | 3\$66 | |
| 0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ | | |
| 0LQLPXP \$FFHSWDEOH (TXLY | | |
| 02' &9 5(68/76 | 3\$66 ZLWK 02 | &9 3\$66 ZLWK 02' &9 |
| 0RGLIHG &9 | | |
| 0LQLPXP \$FFHSWDEOH (TXLY 6DPSOH 0HDQ | | |
| 0LQLPXP \$FFHSWDEOH (TXLY | | |

0DUFK

1&3 53

5HY 1 &

)LJXUH LOOXVWJRDVH & RVPISU HZSVILQR QVVWVUGH QJLQKPPHPD Q
YDOXHV IRU WKH T XDHODQLG DWKLR BTXD PFKOHQEP LWDVSBH
HTXLYDOHQF\ VDP SOHMU DBH E B B Z QZ DWK QW & B WTX DOKHL E B W J H
OLJKWHU FRORUH G HWKLR B REGLU VHDGU & 9I R R P S X W D W L R Q V



0DUFK

1&3 53

5HY 1 &

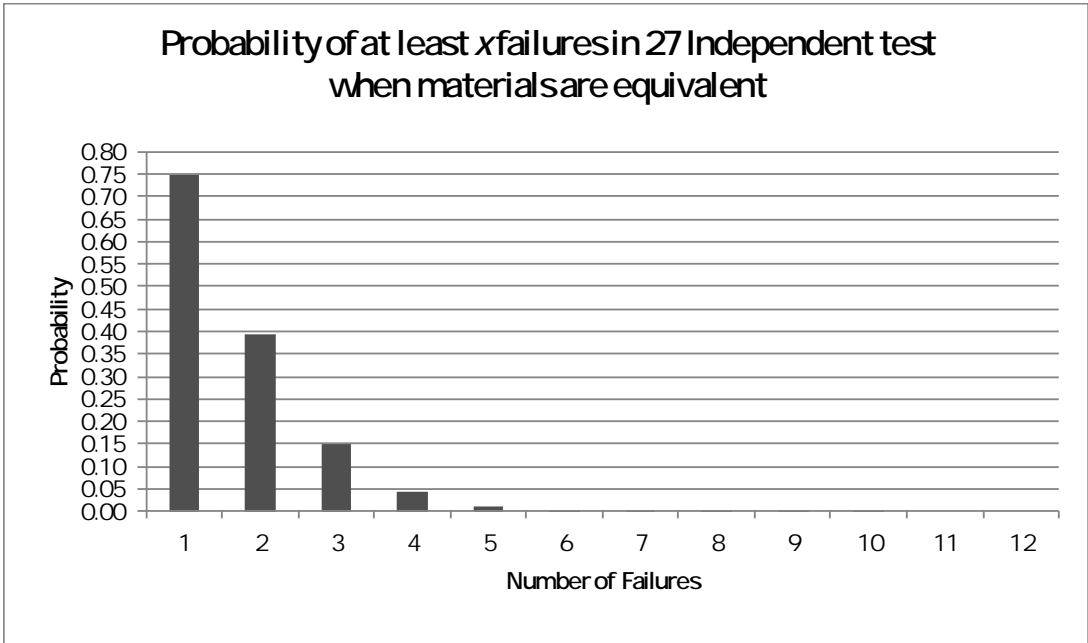
&XUHG 30\ 7KLFNQHV V &37

7KH &XUHG 30\ 7KLFNQHV V G HFDQGEHT XL YD R HQWH DFFVRUOGLVQ R I
SRROHG WZR VDP SOHVOR D EODI VL GFRQIWGM EWH VOWLYHVOIRU ER
RULJLQDO 0+ FXUHLRQ E OHD FSO D LD QGD W KHT & LFYDCH Q FFOV D P S O
DUH VKRZQ LQ 7DEOH

&XUHG 30\ 7KLFNQHV V &37 4XDO (TXLY
\$YHUDJH &XUHG 30\ 7KLFNQHV V
6WDQGDUG 'HYLDWLRQ
&RHIILFLHQW RI 9DULDWLRQ
0LQLPXP
0D[LPXP
1XPEHU RI 6SHFLPHQV

3UREDELOLW\ RI)DLOXUHV

,I WKH HTXLYDOHQFRV DPBDWFUDLPHOIZWWRKVFKGHUOWWFHJLWR
 RULJLQDO TXDODQLDQGLRQOPDMMWLVZRHDHDLQVGHVQW
 FKDQFH RI KDRYLQRQHQLDLOXUHVVXUVH LOOXVWUDWWV WKH
 RI JHWLQJ RQH RWZRRURHIDROXUDDOXHWRIRHWEQGRHS HQGH
 WHVWV ,I WKH WZRHPTXLYDODHQRWZHWKMSUREDELOLWDLQXUH
 LV OHVV WKDQ 7KWK/HPHDQNUWDDWFR&ODG/ERFRVQVTLXGHDH
 ZLWK D OHYHO RI WFRPHGZHQWHIRXUVRURXVCRHSHQSHQW
 WHVWV



)LJXUH 3URIEDXPHLW\RI)DLOXUHV

5HIHUUHQFHV

&0+ 5HY * 9ROXPB\$(,QWHUQDWLRQDODOW&RPPRO
 'ULYH :DUUHQGDH 3\$
 -RKQ 7RPEOLQ <HRZ & 1J Material Qualification 5DMX 3