



# MECH9650

A ]Wfc 'UbX'6]cZi ]X]Wg

HYfa 'Hk c''##'&\$&%

GWcc``cZA YWUub]WU``UbX'A Ubi ZUW# f]b[ '9b[ ]bYYf]b[ ``##'I BGK '9b[ ]bYYf]b[

7ci fgY`Cj Yfj JYk

GHJZZ7cbhUW`8YHU`g

7cbj Ybcfg

B Ua Y	9a Uj`	5j Uj`UVj`]m	@cWUjcb	D\cbY
Gi gUbb`6Y]Yf	g"VY]Yf4 i bgk "YXi "Ui	D`YUgY`fYUW`ci h j ]U`hYUa g`cb`m! Y]hYf`]b`hY U`cWUjX`hYUa `cf j ]U`dfj] UH`a YggU[ Y	>%+	

GWcc`7cbhUW`bZcfa Uh]cb

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I BGK `A YWUbj]WU`UbX`A Ubi ZUW`f]b[ `9b[ ]bYYf]b[

5]bgk cft`Vi ]X]b[ `>%+ž`@Yj Y`%`

5Vcj Y`7cZY`cb`7Ua di g

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-.\$\$-).\$\$da žA cbXUm: f]XUmf

f7`cgYX`cb`di V`]W`c`]XUmž`GWcc`gWYXi `YX`Yj Yb]g`UbX`I b]j Yfg]mG`i hXck b

K YV

[GWcc`cZA YWUbj\]WU`UbX`A Ubi ZUW`f\]b\[ `9b\[ \]bYYf\]b\[](#)

[9b\[ \]bYYf\]b\[ `Gh`XYbhGi ddcfhGYfj \]Wg](#)

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[I BGK `Gh`Xm5VfcUX`UbX`I WUbj \]Y`fZcf`\]bVci bX`gh`XYb\]gk](#)

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D\cbY

fZ`\*%&E`- ' , ) ; ) \$\$`-Bi WYi g`Gh`XYbh<i V

fZ`\*%&E`- ' , ) `+\*\*%`-9b[ ]bYYf]b[ `bXi g]f]U`HfU]b]b[

fZ`\*%&E`- ' , ) `%- -I BGK `Gh`Xm5VfcUX`UbX`I BGK `9I WUbj ]Y`fZcf`]bVci bX`gh`XYb]gk

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HD'YUgY'bcH' hUhi'GY'GWcc'`C ZVW'k ]'`bch\_bck 'k \Yb#Znci f'Wci fgY'Wcbj Ybcf' ]g'cb'WUa di g'cf Uj U]UV'Y

### 9a U]

[9b\[ \]bYYf\]b\[ \]Gh XYbhGi ddcfhGYfj \]Wg](#) -'W ffYbhghi XYbhYbei ]f]Yg

- Y"[ "Ybfc`a Ybž'dfc[ fYgg]cbž'WUg\`fYei Ygrž'Wci fgY' ]ggi Yg'cf'dfc[ fUa !fY`UH'X'ei Yf]Yg

[9b\[ \]bYYf\]b\[ \]`bXi gfh\]U`HfU\]b\]b\[ \]`ei Ygh\]cbg](#)

[\] BGK \]Gh Xm5VfcUX](#) -'ghi XmUVfcUX'ghi XYbhYbei ]f]Yg'fZcf']bVci bX'ghi XYbhgk

[\] BGK \]9i V\U\]b\[ \]Y](#) -'ghi XYbhYi V\U]b[ ]Y'Ybei ]f]Yg'fZcf']bVci bX'ghi XYbhgk

[\] BGK \]: i h'fY'Gh XYbhg](#) -'dch'bh]U`ghi XYbhYbei ]f]Yg

- Y"[ "UXa ]gg]cbgž'ZYgž'dfc[ fUa gž'WYX]h'fUbgZYf

[GWcc'`C ZVW](#) -'GWcc'`[ YbYfU`cZVW'UXa ]b]ghfU]cb'Ybei ]f]Yg

- B 6. h'Y'fY'Yj Ubh'YUa g`]gh'X'UVc] Y'a i gh'VY'Wcb'UWYX'Zcf'U`ghi XYbhYbei ]f]Yg" H'Y'GWcc'`k ]`cb'mVY'UV'Y'hc'fY'Zf'ghi XYbhg'cb'hc'h'Y'fY'Yj Ubh'YUa ]Z'Wcb'UWYX



## 5ggYgga Ybh

A Uf\_g'UFY'fYh fbYX'k ]h]b'&k YY\_g'cZHY'Xi Y'XUHY'

<ck'hc'gi Va ]h'Mci fi'gi Va ]hU''UggYgga Ybhg'j ]U'a ccX'Y'

## 5ggYgga YbhHUg\_g

5ggYgga YbhHUg_g	K Y][ \h	8i Y'8UHY'	Gh XYbh@YUfb]b[ Ci hMta Yg'5ggYggYX
: UVf]W]h]cb'UbX'Yj U'i U]h]cb'cZ U'a ]Wc!a ]l Yf#Zi ]X]Wg grghYa'	&\$i	% #*\$ #&\$&%\$) .\$\$'DA	%ž&ž' ž(ž)
9j U'i UHY'a ]Wc! 'UbX V]cZi ]X]WXYj ]Wg'UbX grghYa g'	&\$i	K - : f] da'	%ž&ž' ž(ž)

cj YfWta Y`hY`dfcV`Ya "hY`hY`Ua`g`cZgh`XYbhg`WJb`WkccgY`Zca`U`fUb[`Y`cZ`UHYghfYgYUfW`h`d`fYgYbhz`X]gW`gg`UbX`Yj`U`i`UH`h`YgY`XYj`JW`g`i`g]b[`h`Y`h`c`g`h`Ym`YUfbYX"

5XX]h]cbU`XYHJ]`g.

5Vgc`i`h`ZJ]`K`%\$`:`f]XUm) da`

5ggYgga`Ybh`. `E`i`]nnYg

GHUfhXUH. `K` )`UbX`K` ,` `A`cbXUm%%%"` \$Ua

@Yb[`h`. `\*`\$a` ]b

8YHJ]`g.

H\Y`gh`XYbhg`k`j``VY`Ug\_YX`h`c`WU`W`UH`fY`Yj`UbhdfcV`Ya`g`W`b`Uf]cg`UbX`Ubgk`Yf`VUg]W`h`W`a`d`Y`I`ei`Yg]h]cbg`h`c`XYa`cbghU`h`h`Y]f`i`bXYfg]UbX]b[`c`Z`h`Y`X]ZY`fY`b`W`V`Y`h`Y`Y`b`a`U`W`c`U`b`X`a`]W`c`Z`i`]X]W`g`U`b`X`h`Y]f`fY`Yj`UbW`Z`c`f`V]c`c[`]W`g`m`g`h`Y`a`g"

5XX]h]cbU`XYHJ]`g.

5Vgc`i`h`ZJ]`K` )`UbX`K` ,` `:`f]XUm) da`

Gi`Va`]gg]cb`b`chYg. `H\Y`fY`U`fY`h`k`c`UggYgga`Ybhg`Z`c`f`h`g`WU`h`[`cfm

5ggYgga`Ybh(. `7`Ugg`W`b`h`f]Vi`h]cb

GHUfhXUH. `K` %`A`cb`

@Yb[`h`. `h`f`ci` [ ` \`ci`h`h`Y`W`ci`fgY

8YHJ]`g.

H\Y`gh`XYbhg`k`j``VY`UggYggYX`cb`h`Y]f`W`b`h`f`Vi`h]cb`h`f`ci` [ ` \`ci`h`h`Y`W`ci`fgY`Z`h`g`k`j``]b`Wi`XY`U`h`Y`b`X`U`b`W`

F Ygci fWg

DfYgWf]VYX`F Ygci fWg`

YHYI hVcc\_

@YWn fY`bchYg`UbX`g`]XYg`

J ]fhi U`@UV

C hYf`A ccX`Y`fYgci fWg`

F YWca a YbXYX`F Ygci fWg

[F YWca a YbXYX`HYI hVcc\\_`6\]cZi \]X`A YWUb\]Wg`!`5b`#dfcXi`W\]cb`hc`:`i \]X`A YWUb\]Wg`ZA UWfcWfW`Uh\]cbz`UbX`A \]WfcWfW`Uh\]cbi`F`@](#)

I BGK `@]VfUfmk YVg]hY.`\`hdg.##`k k`""]VfUfmi bgk "YXi "Ui #

A ccX`Y.`\`hdg.##`a ccX`Y`h`hi bgk "YXi "Ui #c[ ]b#bXYI "d\`d

7ci fgY`9j U`i Uh]cb`UbX`8Yj Y`cda Ybh

: YYXVUW`cb`hY`Wci fgY`]g`[ U hYfYX`dYf]cX]WU`mi g]b[ ] j Uf]ci g`a YUbgz`]bWi X]b[ `hY`I` BGK`  
a m9I dYf]YbW`dfcW`ggz`]bZcfa U`X]gW`gg]cb`]b`hY`Z]bU`WUgg`Zc`f`hY`Wci fgYz`UbX`hY`GWcc`"g`  
Gh`XYbh`GhUZZa`YYh]b[ g`"Mci`f`ZYXVUW`]g`hU`Yb`gYf]ci`g`nž`UbX`Wc`bh]bi`U`"ja`dfc]`Ya`Ybhg`UfY`a`UXY`hc`hY`  
Wci fgY`VUgYXz`]b`dUf]z`cb`gi`W`ZYXVUW`"

Gi Va ]gg]cb'cZ5ggYgga YbhiHUg\_g

5ggYgga Ybhigi Va ]gg]cb'UbX'a Uf\_]b[ 'Wf]hYf]U

G\ci 'X'h\Y'Wci fgY'\Uj Y'Ubmbcb!Y'YVWfcb]WUggYgga Ybhigi Va ]gg]cbž'h\YgY'g\ci 'X'\Uj Y'U'ghUbxUfX  
GWkcc'Wcj Yf'g\YYH'

5`gi Va ]gg]cbg'UfY'YI dYVWY'X'hc'VY'bYUhiUbX'WYUfmgYhici H'Mci f'fYgi 'hg'UfY'h\Y'd]bbUWY'cZU`mci f'\UfX  
k cf\_'UbX'g\ci 'X'VY'hYUhiX'k ]h'Xi Y'fYgdYVW'DfYgYbh]b[ 'fYgi 'hg'WYUfmi[ ]j Yg'h\Y'a Uf\_Yf'h\Y'VYghWUbxWY  
cZi bXYfgtUbx]b[ 'mci f'a Yh\cX/Yj Yb']Zh\Y'bi a Yf]WU'fYgi 'hg'UfY']bVc'ffYVW'

A Uf\_]b[ '[ i ]XY']bYg'Zcf'Ugg][ ba Ybhigi Va ]gg]cbg'k ]`VY'dfcj ]XYX'Uhih\Y'gUa Y'h]a Y'Ug'Ugg][ ba YbhXYH]g  
hc'Ugg]ghk ]h'a YH]b[ 'UggYggUV'Y'fYei ]fYa Ybhg" Gi Va ]gg]cbg'k ]`VY'a Uf\_YX'UWVc'fX]b[ 'hc'h\Y'a Uf\_]b[  
[ i ]XY']bYg'dfcj ]XYX"

@UHY'dc`]Wm

K cf\_gi Va ]hYX'UH'k ]h\ci hUb'Uddfcj YX'YI hYbg]cb'Vmih\Y'Wci fgY'Wc'fX]bUhc'f'cf'XY'Y[ UHY'X'Ui h\cf]hm]g  
gi VYVWih'U'UH'dYbU'micZ&\$'dYfW'bhf&\$i 'E'cZh\Y'a U] ]a i a 'a Uf\_'dcgg]V'Y'Zcf'hUhiUggYgga Ybh]hYa ž  
dYf'WU'YbXUf'XUm'

H\Y'UH'dYbU'mi]g'Udd'YX'dYf'WU'YbXUf'XUm]bWi X]b[ 'k YY\_YbXg'UbX'di V]W\c'XUmg'U'Uhih\Y  
UggYgga Ybh]g'c] YfXi Y'"H\YfY']g'bc'dfc!fUHU'cZh\Y'UH'dYbU'miZcf'gi Va ]gg]cbg'a UXY'dUfhk Umih\ci [ '\U  
XUm'

K cf\_gi Va ]hYX'UZfY'h\Y'XYUX']bY'Zcf'UVgc'i h'ZU]' ]g'bcUWVW'dhYX'UbX'U'a Uf\_'cZnYfc'k ]`VY'Uk UfXYX  
Zcf'hUhiUggYgga Ybh]hYa "

: cf'gca Y'UggYgga Ybh]hYa gžU'UH'dYbU'mia UmibchVY'Uddfcdf]UH'" H\YgY'UfY'WYUfmi]bX]WUhiX']b'h\Y  
Wci fgY'ci h]bYž'UbX'gi W'UggYgga Ybhg'fYVW'j Y'U'a Uf\_'cZnYfc']ZbchWca d'YhX'Vmih\Y'gdYVW]ZYX'XUH'"  
9I Ua d'Yg']bWi XY.

% K YY\_'micb']bY'hYgh'cf'UVcfUhc'fmik cf\_'k cffh'U'ga U'dfc'dcf]cb'cZh\Y'gi VYVWia Uf\_ž'cf  
&" C b']bY'ei ]nnYg'k \YfY'Ubgk Yfg'UfY'fY'UgYX'hc'gfi XYbhg'cb'Wca d'Yh]cbž'cf  
' " DfcZYgg]cbU'UggYgga YbhHUg\_gžk \YfY'h\Y']bhYbh]cb ]g'hc'WYUhi'Ub'Ui h\Ybh]WUggYgga Ybh'h\U  
\Ug'Ub'UVgc'i h'gi Va ]gg]cb'XUH'ž'cf  
(" DUgg# U]'UggYgga YbhHUg\_g"

9I Ua ]bUH]cbg



UggYgga YbhdYfZcfa UbWžmci 'UfY'Y'[ ]V'Y'hc'Udd'mZcf'GdYWU'7 cbg]XYfUhc'b'df]cf'hc'gi Va ]h]b[ 'Ub  
UggYgga Ybhcf'g]h]b[ 'Ub'YI Ua "

I BGK 'bck '\Ug'U': [Jhrc'G\]h#Gi Va \]hfi\\_Yžk \\]](#)W'a YUbg'hUh]Zmci 'UhtYa dhUb'YI Ua 'cf'gi Va ]hU'd]YW'cZ  
UggYgga Ybhžmci 'UfY'XYWUf]b[ 'mci fgY'Z]hYbci [ \ 'hc'Xc'gc'UbX'WUbbch'Uhtf'Udd'mZcf'GdYWU'  
7 cbg]XYfUhc'b"

: cf'XYHU]g'cZUdd'm]b[ 'Zcf'GdYWU'7 cbg]XYfUhc'b'UbX'WcbX]h]cbg'Zcf'hY'Uk UfX'cZgi dd'Ya YbhUfm  
UggYgga Ybhž'd'YUgY'gYY'hY'jbZcfa Uhc]b'cb'I BGK 'g' [GdYWU'7 cbg\]XYfUhc'b'dU\[ Y"](#)

D'YUgY'bc'hY'hUhghi XYbhg'k ]'bchVY'fYei ]fYX'hc'dfcj ]XY'UbmXcW a YbhUfmYj ]XYbW'hc  
gi ddcfhUVgYbW'g'Zca 'UbmWUggYg'a ]ggYX'VYWU]i gY'cZ7CJ -8!%- 'di V']W\YU'h' a YUgi fYg'gi W'Ug  
]gc'Uh]cb" I BGK 'k ]'bchVY' ]bg]gh]b[ 'cb'a YX]W'Wf]h]Z]W]hYg'Zca 'UbmcbY'XYYa YX'hc'VY'U'dcg]h] Y'WUgYž  
cf'k \Yb'hYm\Uj Y'fYVčj YfYX" 'Gi W'Wf]h]Z]W]hYg'UfY'X]Z]W'h'hc'cVhU]b'UbX'di hUb'i bbYW'ggUfmgfU]b'cb  
ghi XYbhg'UbX'a YX]W'ghUZZ'

5dd']W]h]cbg'Zcf'gdYWU'Wcbg]XYfUhc'b'k ]'VY'fYei ]fYX'Zcf'UggYgga YbhUbX'dUfh]W]dUhc'b'UVgYbW'g'—  
Vi hbc'XcW a YbhUfmYj ]XYbW'Zcf'7CJ -8 %- ]'bYgg'cf']gc'Uh]cb'k ]'VY'fYei ]fYX"

## 5 WUXYa ]W< cbYgmiUbX`D`U[ ]Uf]ga

I BGK `Ug`Ub`cb[c]b[ `Wca a ]ha Ybhlc`ZcghYf]b[ `U`W`hi fY`cZ`YUfb]b[ `]bZcfa YX`VmiUWUXYa ]W]bhY[ f]m`5`  
I BGK `gh`XYbhg`Uj`Y`U`fYgdcbg]V`]hmlc`UX`YfY`hc`h`g`df]bW]d`Y`cZUWUXYa ]W]bhY[ f]m`D`U[ ]Uf]ga  
i bXYfa ]bYg`UWUXYa ]W]bhY[ f]m]UbX`]g`bchlc`YfUHX`Uhl`BGK`"B`SY[Sde\_`SfG@E|`[e VWX` VW`Se ge[`Y`  
fZWi`ad/e`ad[VWSe`aXafZW`S`V`bSee[`Y`fZW\_`aXSe`kagdai` `z`

D`U[ ]Uf]ga` ]g`U`hmdY`cZ]bhY`YW`i`U`h`YZ`i`#iW]b`hU`\_Y`a`UbmiZcfa`gZ`Zca` `XY`]VYfUHX`WX`YU]b[ `hc`UWUXYbH`U`m`  
W`dm]b[ `Zca`U`gci`fW`k`]h`ci`hUW`bck`YX[`Ya`Ybh`I`BGK` `Ug`dfcXi`WX`U`k`YVg]h`k`]h`U`k`YU`h`cZ`  
fYgci`fW`g`hc`gi`ddcfghi`XYbhg`hc`i`bXYfgHUbX`UbX`Uj`c]X`d`U[ ]Uf]ga`z`j`]g]h`[gh`XYbh`i`bgk`"YXi`"Ui`#d`U\[ \]Uf\]ga`"](#)  
H`Y`@YUfb]b[ `7`YbhY`Ugg]ghg`gh`XYbhg`k`]h`i`bXYfgHUbX]b[ `UWUXYa ]W]bhY[ f]m]UbX` \ck`bchlc`d`U[ ]Uf]gY`  
H`Y`miU`gc` \c`X`k`cf\_g`l`cdg`UbX`W]b` \Y`d`gh`XYbhg`cbY!cb!cbY`"

Mci`U`fY`U`gc`fYa`]bXYX`h`UhWUfYZ` `h`a`Y`a`UbU[`Ya`Ybh]g`Ub`]a`dcfHUbhdUfHicZghi`XmiUbX`cbY`cZ`h`Y`  
]XYbh]ZYX`W]i`gYg`cZd`U[ ]Uf]ga` ]g`d`ccf`h`a`Y`a`UbU[`Ya`Ybh`G`h`XYbhg`g`l`ci`X`U`ck`gi`Z]W]Ybh]h`a`Y`Zc`f`  
fYgYUfW`Z`X`fU`Z]b[ `UbX`h`Y`dfcdYf`fY`Z`fY`bW]b[ `cZ`gci`fW`g`]b`dfYdUf]b[ `U`UggYgga`Ybh]Ug\_g`"

=Zd`U[ ]Uf]ga` ]g`Zci`bX`]b`mci`f`k`cf`\_`k` \Yb`mci`U`fY`]b`Z]fghmYUfZ`mci`f`YW`i`fYf`k`]`c`ZYf`mci`Ugg]ghU`bW`hc`  
]a`dfcj`Y`mci`f`UWUXYa ]Wg\_]`g`"H`Y`mia`UmUg\_`mci`hc`cc\_`Uhgca`Y`cb`]bY`fYgci`fW`gZ`U`hY`bX`h`Y`@YUfb]b[`  
7`YbhY`Zcf`gca`Y`h`a`Yg`fYgi`Va`]h`mci`f`k`cf`\_`k`]h`h`Y`dfcV`Ya`Z]YX`"<ck`Yj`Yf`a`cfY`gYf]ci`g`]bgHUbW`g`]b`Z]fgh`  
mYUfZ`gi`W`Ug`gh`U`]b[ `UbchYf`gh`XYbhg`k`cf`\_`cf`dUm]b[ `gca`YcbY`hc`Xc`mci`f`k`cf`\_`za`UmVY`]bj`Ygh[`UH`X`  
i`bXYf`h`Y`G`h`XYbhA`]gW`bXi`W`h`DfcW`Xi`fYg`"

F`YdYUHX`d`U[ ]Uf]ga`fYj`Yb`]b`Z]fghmYUfZ`d`U[ ]Uf]ga`UZYf`Z]fghmYUfZ`cf`gYf]ci`g`]bgHUbW`gZ`a`UmU`gc`VY`  
]bj`Ygh[`UH`X`i`bXYf`h`Y`G`h`XYbhA`]gW`bXi`W`h`DfcW`Xi`fYg`"H`Y`dYbU`h`Yg`i`bXYf`h`Y`dfcW`Xi`fYg`W]b`]bW`i`XY`  
U`fYXi`W`h`cb`]b`a`Uf\_gZ`Z]b[ `U`W`i`fgY`cf`Zc`f`h`Y`a`cghgYf]ci`g`a`UH`Y`fg`f]\_Y`d`U[ ]Uf]ga` ]b`Ub` \cbci`fg`  
h`Y`g]g`E`Yj`Yb`gi`gdYbg]cb`Zca`h`Y`i`b]`Yfg]m`H`Y`G`h`XYbhA`]gW`bXi`W`h`DfcW`Xi`fYg`UfY`Uj`U]UV`Y` \YfY`.

[k`k`k`"\[g`i`bgk`"YXi`"Ui`#d`U\[ \]Uf\]ga`\]W`<`cb`Y`g`m`i`U`b`X` `D` `U`\[ `\]`U`f`\]`g`a`"\]`g`\]`h` `g`h` `X`Y`b`h` `i` `b`g`k` ` "Y`X`i` ` "U`i` `#`d` `U`\[ `\]`U`f`\]`g`a` `"\]`g`\]`h` `g`h` `X`Y`b`h` `A` `\]`g`W` `b`X`i` `W` `h` `D` `f` `c` `W` `X`i` `f` `Y` `g` `d` `X` `Z` `](#)

5 WUXYa ]W=Zcfa Uh]cb

7 fYX]hdc]bhg

7 ci fgY`WYX]hg`W`W`UH`X`]b`I` b]hg!C Z 7 fYX]hfl C 7 E`H`Y`bcfa U`k cf`cUX`YI dYWUh]cb`Zf`cbY`I C 7

- [AccXY](#)
- [@UV5WYgg](#)
- [7ca di hb\[ : UW\]hYg](#)
-

