



# MECH9650

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

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

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

7ci fgY`Cj Yfj JYk

GHJZZ7cbhJW`8YHJ`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`7cbhJW`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[ `>%+z`@Yj Y`%`

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

<ci fg

-.\$\$-).\$\$da z`A cbXUm: f]XUmf

f7`cgYX`cb`di V`]W`c`]XUmgz`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](#)

[9b\[ \]bYYf\]b\[ `bXi g\]f\]U`HfU\]b\]b\[](#)

[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

fZ`\*%&E`-`'` , ) `( \$`-`+`-`GWcc`C Z]WYf

HD`YUgY`bch`h`Uhi`h`Y`GWcc`C`Z`W`k`j`bch\_bck`k`Yb#Znci`f`Wci`fgY`Wcbj`Ybcf`jg`cb`Wla`di`g`cf`Uj`Uj`UV`Y

9a Uj`

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

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

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

[\]`BGK` \]Gh`Xm5VfcUX`](#) -`gh`XmUVfcUX`gh`XYbhYbei`]f]Yg`fZcf`]bVci`bX`gh`XYbhtg`

[\]`BGK` \]9\]`WU\]b\[ \]Y`](#) -`gh`XYbhYI`WU]b[ ]Y`Ybei`]f]Yg`fZcf`]bVci`bX`gh`XYbhtg`

[\]`BGK` \]`i`h`fY`Gh`XYbhtg`](#) -`dch`bh]U`gh`XYbhYbei`]f]Yg

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

[GWcc`C`Z`W`](#) -`GWcc`C`Z`W`YbYfU`c`Z`W`UXa`]b]ghfU]cb`Ybei`]f]Yg

- B 6. `h`Y`fY`Yj`Ubh`h`Ua`g`]gh`X`UVc]`Y`a`i`gh`VY`W`b`h`U`W`X`Z`c`f`U`gh`XYbhYbei`]f]Yg`" `H`Y`G`W`c`c`k`j`cb`m`VY`UV`Y`h`c`fY`Z`f`gh`XYbhtg`cb`h`c`h`Y`fY`Yj`Ubh`h`Ua`]Z`W`b`h`U`W`X`



## 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 dfcVYa "hY hYUa g:cZgh XYbhg WJb WkccgY Zca U'fUb[ Y'cZ'UHghfYgYUfW'hc'dfYgYbhž X]gW gg UbX'Yj U'i UH' hYgY XYj ]Wg'i g]b[ 'hY'hc'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 ]''VY'Ug\_YX'hc'WU'W 'UH'fY'Yj UbhdfcVYa 'gW'fUf]cg'UbX'Ubgk Yf'VUg]W'hc'Wta d'YI ei Ygh]cbg'hc'XYa cbghU'f' hY]f'i bXYfg]UbX]b[ 'cZ'hY'X]ZY'fYbW'VY'hk YYb'a UW'c'UbX'a ]W'cZi ]X]Wg'UbX hY]f'fY'Yj UbW'Z'f'V]c'c[ ]W'gmg]hYa g"

5XX]h]cbU'XYHJ]g.

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

Gi Va ]gg]cb'bc]hYg. 'H\YfY'UfY'fk c'UggYgga Ybhg'Z'f'h]g'WUH] [ cfm

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

GHUfhXUH. 'K %A cb'

@Yb[ h. 'h'fci [ \ci h'hY'W'ei fgY

8YHJ]g.

H\Y'gh XYbhg'k ]''VY'UggYggYX'cb'hY]f'W'cb]f]Vi h]cb'h'fci [ \ci h'hY'W'ei fgY'Z'h]g'k ]'']bWi XY'UH'fYbXUbW'

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`[`Uh`YfYX`dYf]cX]WU`mi`g]b[ ]`j`Uf]ci`g`a`YUbgz`]bWi`X]b[`h`Y`I`BGK`a`m9I`dYf]YbW`dfcW`ggz`]bZcfa`U`X]gW`gg]cb`]b`h`Y`Z]bU`WUgg`Zc`f`h`Y`Wci`fgYz`UbX`h`Y`GWcc`"g`Gh`XYbh`GhUZZa`YYh]b[`g`"Mci`f`ZYXVUW`\_]g`hU`Yb`gYf]ci`g`nž`UbX`Wc`bh]bi`U`"ja`dfcj`Ya`Ybhg`UfY`a`UXY`hc`h`Y`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 dYVWYX'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'fYgdYWf'DfYgYbh]b[ 'fYgi 'hg'WYUfm[ ]j Yg'h\Y'a Uf\_Yf'h\Y'VYghWUbxW  
cZi bXYfgtUbx]b[ 'mci f'a Yh\cX/Yj Yb']Zh\Y'bi a Yf]WU'fYgi 'hg'UfY']bVc'ffYWf'

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[ UHYX'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!fUfU'cZh\Y'UH'dYbU'miZcf'gi Va ]gg]cbg'a UXY'dUfhk Umih\ci [ \ 'U  
XUm'

K cf\_gi Va ]hYX'UZf'h\Y'XYUX']bY'Zcf'UVgc'i h'ZU]' ]g'bchUWVW'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'WYUfm]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'gdYV]ZYX'XUH'"  
9I Ua d'Yg']bWi XY.

% K YY\_'micb']bY'hYgh'cf'UVcfUhc'fmik cf\_'k cff'h'U'ga U'dfc'dcf]cb'cZh\Y'gi VYVWia Uf\_ž'cf  
&" C b']bY'ei ]nnYg'k \YfY'Ubgk Yfg'UfY'fY'YUgYX'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'hU  
\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': [\]h\]c'G\]h#Gi Va \]hfi\\_Yžk \\]](#)W'a YUbg'hUh]Zmci 'UfY'a dhUb'YI Ua 'cf'gi Va ]hU'd]YW'cZ  
UggYgga Ybhžmci 'UfY'XYWUf]b[ 'mci fgY'Z]hYbci [ \ 'hc'Xc'gc'UbX'WUbbch'UfY'Udd'mZcf'GdYWU'  
7 cbg]XYfUhc'b"

: cf'XYfU]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'YUg'gY'Y'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 ddcfhiUVgYbW'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]WUhg'Zca 'UbmcbY'XYa YX'hc'VY'U'dcg]h]Y'WUgYž  
cf'k \Yb'hYm\Uj Y'fYVčj YfYX" 'Gi W'Wf]h]WUhg'UfY'X]Z]W'h'hc'cVh]b'UbX'di hUb'i bbYW'ggUfm]gh]U]b'cb  
gh XYbhg'UbX'a YX]W'gh]UZZ'

5dd']W]h]cbg'Zcf'gdYWU'Wcbg]XYfUhc'b'k ]'VY'fYei ]fYX'Zcf'UggYgga YbhUbX'dUf]h]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`h`fY`cZ`YUfb]b[ `]bZcfa YX`VmiUWUXYa ]W]bhY[ f]m`5`  
I BGK `gh`XYbhg`Uj`Y`U`fYgdcbg]V`]mhc`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``ž

D`U[ ]Uf]ga` ]g`U`hmdY`cZ]bhY`YW`i`U`h`YZ`h`#`WUb`hU`\_`Y`a` UbmiZcfa`gž`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`ddcfhgh`XYbhg`hc`i`bXYfgHUbX`UbX`Uj`c]X`d`U[ ]Uf]ga`ž`]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`mi`U`gc`lc`X`k`cf`g`cdg`UbX`WUb`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`ja`dcfHUbhdUfhcZgh`XmiUbX`cbY`cZ`h`Y`  
]XYbh]Z`YX`W`li`gYg`cZ`d`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`Y`bh`h`a`Y`Z`c`f`  
fYgYUfW`ž`X`fU`Z]b[ `UbX`h`Y`dfcdYf`fY`Z`fY`bW]b[ `cZ`gci`fW`g`]b`dfY`dUf]b[ `U`UggYgga`YbhH`g`g`"

ž`d`U[ ]Uf]ga` ]g`Z`ci`bX`]b`mci`f`k`cf`\_`k`Y`b`mci`U`fY`]b`Z`fghmY`Ufž`mci`f`Y`W`h`fY`f`k`]`c`Z`Y`f`mci`Ugg]ghU`bW`hc`  
]a`dfcj`Y`mci`f`UWUXYa ]Wg\_]`g`"H`Y`ma`UmUg`\_`mci`hc`cc`\_`Uh`gca`Y`cb`]bY`fYgci`fW`gž`U`h`Y`bX`h`Y`@`YUfb]b[  
7`YbhY`ž`cf`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`  
mY`Ufž`gi`W`Ug`gh`U`]b[ `Ubch`Y`f`gh`XYbhg`k`cf`\_`cf`dU]b[ `gca`YcbY`hc`Xc`mci`f`k`cf`\_`ž`a`UmVY`]bj`Ygh[`UH`X`  
i`bXYf`h`Y`G`h`XYbhA`]gW`b`Xi`W`h`D`fc`W`Xi`fYg`"

F`YdYUH`X`d`U[ ]Uf]ga`fYj`Yb`]b`Z`fghmY`Ufž`d`U[ ]Uf]ga`U`Z`Y`f`Z`fghmY`Ufž`cf`gYf]ci`g`]bgHUbW`gž`a`UmU`gc`V`Y`  
]bj`Ygh[`UH`X`i`bXYf`h`Y`G`h`XYbhA`]gW`b`Xi`W`h`D`fc`W`Xi`fYg`"H`Y`d`Yb`U`h`Y`g`i`bXYf`h`Y`dfc`W`Xi`fYg`W`Ub`]b`W`i`XY`  
U`fY`Xi`W`h`cb`]b`a`Uf`gž`Z]b[ `U`W`i`fgY`cf`Z`c`f`h`Y`a`cghgYf]ci`g`a`U`h`Y`fg`f]l`\_`Y`d`U[ ]Uf]ga` ]b`Ub`l`cbci`fg`  
h`Y`g]g`L`Yj`Yb`gi`gdYbg]cb`Z`ca`h`Y`i`b]`Yfg]m`H`Y`G`h`XYbhA`]gW`b`Xi`W`h`D`fc`W`Xi`fYg`UfY`Uj`U]UV`Y`Y`fY`.

[k`k`k`"\[g`i`bgk`"YXi`"Ui`#d`U\[ \]Uf\]ga`\]W<`cbYgmiUbX`D`U\[ \]Uf\]ga`\]gW`b`Xi`W`h`D`fc`W`Xi`fYg`"dXZ`](#)

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](#)
-

