APPENDIX 1

SUMMARY TABLES OF GENETIC AND RELATED EFFECTS

Summary table of genetic and related effects of chromium compounds

	Nonmammalian systems													Mammalian systems																											
	Prokaryotes		Lower eukaryotes				Plants			Insects				*In vitro*																*In vivo*											
														Animal cells								Human cells								Animals							Humans				
	D	G	D	R	G	A	D	G	C	R	G	C	A	D	G	S	M	C	A	T	I	D	G	S	M	C	A	T	I	D	G	S	M	C	DL	A	D	S	M	C	A
Cr[III] compounds																																									
Chromic chloride [$CrCl_3.6H_2O$]	–	–		+[1]	+[1]									–		–		+		–		–		–		?	+[1]			–											
Chromic acetate [$Cr(CH_3COO)_3$]	?	–													–	?		+						+[1]		+[1]															
Chromic nitrate [$Cr(NO_3)_3.9H_2O$	+	–							+[1]					–[1]		–		–								–[1]							–[1]								
Chromic sulfate [$Cr_2(SO_4)_3$–4–$8H_2O$]	–	–														–		?																							
Chromic potassium sulfate [$CrK(SO_4)_2.[2H_2O]$	–	–					+[1]									–		+																							
Chromium alum [$Cr_2(SO_4)$)]$_3$.$K_2SO_4.H_2O$]		–														–		+																							
Neochromium [$Cr_2(OH)SO_4.Na_2SO_4.H_2O$]		–														–[1]		+[1]																							
Chromic oxide [Cr_2O_3]	–[1]														+[1]	?																									
Chromite ore [$Cr_2O_3.Fe_2O_3.Al_2O_3.SiO_2.CaO$]		(+)														(+)		(+)																							
Cupric chromite [$Cr_2O_3.2CuO$]														+[1]																											

Chromium compounds (contd)

Nonmammalian systems														Mammalian systems																													
Prokaryotes		Lower eukaryotes				Plants			Insects				*In vitro*																*In vivo*														
													Animal cells						Human cells										Animals								Humans						
D	G	D	R	G	A	D	G	C	R	G	C	A	D	G	S	M	C	A	T	I	D	G	S	M	C	A	T	I	D	G	S	M	C	DL	A	D	S	M	C	A		
Cr[VI] compounds																																						+		+	+[1]		
Potassium dichromate [$K_2Cr_2O_7$]																																											
+	+		+	+	+[1]					+		+[1]	+	+	+		+		+		+		+			+[1]																	
Sodium dichromate [$Na_2Cr_2O_7.2H_2O$]																																											
+	+									+[1]			+[1]		+		+								+[1]					+					+[1]									
Ammonium dichromate [$(NH_4)_2Cr_2O_7$]																																											
+																																											
Potassium chromate [K_2CrO_4]																																											
+	+							–[1]					+	+[1]	+		+	–[1]	?			+		+									+[1]	+										
Sodium chromate [Na_2CrO_4]																																											
+	+												+	+[1]	+		+		+[1]							+[1]																		
Ammonium chromate [$(NH_4)_2CrO_4$]																																												
+[1]	+																																										
Chromium trioxide [CrO_3]																																												
+	+			+	+[1]	–[1]		?		+[1]		–[1]	+[1]		+		+							+[1]		+[1]																		
Calcium chromate [$CaCrO_4$]																																												
?	+				+[1]						+[1]	+[1]	+	+	+		+		+			+[1]		+[1]			+[1]																	
Strontium chromate [$SoCrO_4$]																																												
	+[1]														+[1]				–[1]																									
Zinc yellow [$Zn(CrO_4)$-$Zn(OH)_2$ + 10% CrO_3]																																												
	+														+		+																										
Zinc chromate [$ZnCrO_4$]																																												
	+[1]													+[1]	+[1]		+[1]		+[1]																									
Chromium orange [$PbCrO_4.PbO$]																																												
	+														+		+																										

Chromium compounds (contd)

Nonmammalian systems														Mammalian systems																									
Prokaryotes		Lower eukaryotes				Plants			Insects					*In vitro*																*In vivo*										
														Animal cells								Human cells								Animals							Humans		
D	G	D	R	G	A	D	G	C	R	G	C	A		D	G	S	M	C	A	T	I	D	G	S	M	C	A	T	I	D	G	S	M	C	DL	A	D	S	M
Molybdenum orange [$PbCrO_4.PbSO_4.SiO_2.Al_2O_3.PbMoO_4$]																																						
	+[1]															+		+[1]																					
Barium chromate [$BaCrO_4$]																																						
	–[1]															+[1]																								
Lead chromate [$PbCrO_4$]																																						
–	(+)		(+)[1]							(+)[1]				–[1]	–	+		+		+				(+)[1]	+[1]	(+)[1]							+[1]						
Chromium yellow [$PbCrO_4.PbSO_4.SiO_2.Al_2O_3$]																																						
	(+)[1]															+		+[1]																					
Chromyl chloride [Cl_2CrO_2]																																						
	+																																						
Other Cr compounds																																						
Chromous[II] chloride [$CrCl_2$]																																						
+[1]														–[1]				–[1]								–[1]													
Chromium[0] carbonyl [$Cr(CO)_4$]																																						
–[1]	–[1]																																						

A, aneuploidy; C, chromosomal aberrations; D, DNA damage; DL, dominant lethal mutation; G, gene mutation; I, inhibition of intercellular communication; M, micronuclei; R, mitotic recombination and gene conversion; S, sister chromatid exchange; T, cell transformation

In completing the tables, the following symbols indicate the consensus of the Working Group with regard to the results for each endpoint:

+ considered to be positive for the specific endpoint and level of biological complexity

+[1] considered to be positive, but only one valid study was available to the Working Group

[+] results were available only for products contaminated with traces of Cr[VI]

(+) positive when artificially solubilized in acids or alkali

– considered to be negative

–[1] considered to be negative, but only one valid study was available to the Working Group

? considered to be equivocal or inconclusive (e.g., there were contradictory results from different laboratories; there were confounding exposures; the results were equivocal)

Summary table of genetic and related effects of nickel compounds

Nonmammalian systems														Mammalian systems																													
Prokaryotes		Lower eukaryotes				Plants			Insects				*In vitro*																*In vivo*															
													Animal cells								Human cells								Animals							Humans							
D	G	D	R	G	A	D	G	C	R	G	C	A	D	G	S	M	C	A	T	I	D	G	S	M	C	A	T	I	D	G	S	M	C	DL	A	D	S	M	C			
Metallic nickel																																										
																			+[1]						-[1]																	
Nickel oxides																																										
-[1]																			+						-[1]		+[1]														
Nickel sulfide (amorphous)																																										
													-						-																						
Nickel sulfide (crystalline)																																										
		+[1]											+	+[1]	+[1]		+		+																						
Nickel subsulfide																																									
		+[1]											+[1a]	+					+			-[1]	+[1]				+[1]														
Nickel chloride																																									
?	-		+[1]	+[1]					-				+	+	+		+		+[1]						+[1]								-[1]	+	-[1]						
Nickel sulfate																																										
	-									+[1]		+[1]		+[1b]	+		+[1]		+	+[1]	+[1]	-[1]		+		+[1]		+					-									
Nickel nitrate																																										
-[1]	-[1]								-																								-[1]		-						
Nickel acetate																																										
+[1c]	-[1]																+										+[1]														
Nickel carbonate																																										
																													+												
Nickel subselenide																																										
																			+[1]																						

Nickel compounds (contd)

Nonmammalian systems														Mammalian systems																											
Prokaryotes		Lower eukaryotes				Plants			Insects					*In vitro*																				*In vivo*								
														Animal cells								Human cells								Animals							Humans			
D	G	D	R	G	A	D	G	C	R	G	C	A		D	G	S	M	C	A	T	I	D	G	S	M	C	A	T	I	D	G	S	M	C	DL	A	D	S	M	C
Nickelocene																																								
–[1]																																								
Nickel potassium cyanide																																								
														+[1]																											

A, aneuploidy; C, chromosomal aberrations; D, DNA damage; DL, dominant lethal mutation; G, gene mutation; I, inhibition of intercellular communication; M, micronuclei; R, mitotic recombination and gene conversion; S, sister chromatid exchange; T, cell transformation

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– considered to be negative

–[1] considered to be negative, but only one valid study was available to the Working Group

? considered to be equivocal or inconclusive (e.g., there were contradictory results from different laboratories; there were confounding exposures; the results were equivocal)

[a]Negative result in one study for unscheduled DNA synthesis

[b]Negative result in one study for gene mutation to ouabain resistance in Syrian hamster embryo cells

[c]Negative result in one study for differential toxicity in *Escherichia coli*

Summary table of genetic and related effects of welding fumes

Nonmammalian systems													Mammalian systems																													
Prokaryotes		Lower eukaryotes				Plants			Insects				*In vitro*																*In vivo*													
													Animal cells								Human cells								Animals							Humans				
D	G	D	R	G	A	D	G	C	R	G	C	A	D	G	S	M	C	A	T	I	D	G	S	M	C	A	T	I	D	G	S	M	C	DL	A	D	S	M	C	A
Welding fumes from mild steel																																									
MIG																																									
$-^1$	–														$-^1$		$-^1$														$-^1$		–								
MMA																																									
$-^1$	+														$+^1$		$-^1$														$-^1$		–								
Welding fumes from stainless steel																																						?	$-^1$	?		
MIG																																									
$-^1$	+														+		+		$+^1$												$-^1$		–								
MMA																																									
$+^1$	+													?	+		+		$+^1$												$+^1$	$-^1$		–							
Welding fumes from mild steel or cast iron with nickel-rich electrode																																									
	$-^1$													$-^1$			$-^1$				$+^1$										$-^1$		–								

A, aneuploidy; C, chromosomal aberrations; D, DNA damage; DL, dominant lethal mutation; G, gene mutation; I, inhibition of intercellular communication; M, micronuclei; R, mitotic recombination and gene conversion; S, sister chromatid exchange; T, cell transformation

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– considered to be negative

$-^1$ considered to be negative, but only one valid study was available to the Working Group

? considered to be equivocal or inconclusive (e.g., there were contradictory results from different laboratories; there were confounding exposures; the results were equivocal)