N,N-Dimethylformamide; CASRN 68-12-2

Human health assessment information on a chemical substance is included in the IRIS database only after a comprehensive review of toxicity data, as outlined in the IRIS assessment development process. Sections I (Health Hazard Assessments for Noncarcinogenic Effects) and II (Carcinogenicity Assessment for Lifetime Exposure) present the conclusions that were reached during the assessment development process. Supporting information and explanations of the methods used to derive the values given in IRIS are provided in the guidance documents located on the IRIS website.

STATUS OF DATA FOR N,N-Dimethylformamide

File First On-Line 10/01/1990

Category (section)	Assessment Available?	Last Revised
Oral RfD (I.A.)	not evaluated	
Inhalation RfC (I.B.)	yes	10/01/1990
Carcinogenicity Assessment (II.)	not evaluated	

I. Chronic Health Hazard Assessments for Noncarcinogenic Effects

I.A. Reference Dose for Chronic Oral Exposure (RfD)

Substance Name — N,N-Dimethylformamide
CASRN — 68-12-2

Not available at this time.

I.B. Reference Concentration for Chronic Inhalation Exposure (RfC)

Substance Name — N,N-Dimethylformamide
CASRN — 68-12-2
Last Revised — 10/01/1990

The inhalation Reference Concentration (RfC) is analogous to the oral RfD and is likewise based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis. The inhalation RfC considers toxic effects for both the respiratory system (portal-of-entry) and for effects peripheral to the respiratory system (extrarespiratory effects). It is expressed in units of mg/cu.m. In general, the RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Inhalation RfCs were derived according to the Interim Methods for Development of Inhalation Reference Doses (EPA/600/8-88/066F August 1989) and subsequently, according to Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry (EPA/600/8-90/066F October 1994). RfCs can also be derived for the noncarcinogenic health effects of substances that are carcinogens. Therefore, it is essential to refer to other sources of information concerning the carcinogenicity of this substance. If the U.S. EPA has evaluated this substance for potential human carcinogenicity, a summary of that evaluation will be contained in Section II of this file.

I.B.1. Inhalation RfC Summary

Critical Effect	Exposures*	UF	MF	RfC
Digestive disturbances and mininal hepatic changes suggestive of liver abnormalities **Human Occupational Studies** **Cirla et al.,1984; Catenacci et al., 1984**	NOAEL: None LOAEL: 22 mg/cu.m LOAEL (ADJ): 7.9 mg/cu.m LOAEL (HEC): 7.9 mg/cu.m	300	1	3E-2 mg/cu.m

*Conversion Factors: MW = 73.09. This is an extrarespiratory effect of a soluble vapor. The LOAEL is based on an 8-hour TWA occupational exposure. MVho = 10 cu.m/day, MVh = 20 cu.m/day. LOAEL(ADJ) = 22 mg/cu.m x (MVho/MVh) x 5 days/7 days = 7.9 mg/cu.m.

I.B.2. Principal and Supporting Studies (Inhalation RfC)

Cirla, A.M., G. Pisati, E. Invernizzi and P. Torricelli. 1984. Epidemiological study on workers exposed to low dimethylformamide concentrations. G. Ital. Med. Lav. 6(3-4): 149-156.

Catenacci, G., D. Grampella, R. Terzi, A. Sala and G. Polline. 1984. Hepatic function in subjects exposed to environmental concentrations of DMF lower than the actually proposed TLV. G. Ital. Med. Lav. 6(3-4): 157-158.

Cirla et al. (1984) and Catenacci et al. (1984) were chosen as co-critical studies. The Cirla study shows increases in subjective symptoms suggestive of mild liver dysfunction in workers and changes in objective measurements of liver damage (serum enzymes and liver enlargement) that are of questionable biological significance. Catenacci et al. (1984) report no effects on liver function tests in workers exposed to lower average concentrations than those in the Cirla study. However, the Catenacci study included fewer exposed workers and did not evaluate subjective symptoms. Therefore, the LOAEL in Cirla et al. (1984) was used for the RfC derivation.

In an attempt to characterize the health effects associated with occupational exposure to DMF, Cirla et al. (1984) conducted an epidemiological study of 100 workers exposed to a mean concentration of 22 mg/cu.m DMF (range of 8 to 58 mg/cu.m, determined with personal air sampler) for an average of 5 years (range of 1 to 15 years) and compared the results with those obtained from 100 pair-matched referent controls. The authors accounted for alcohol ingestion, cigarette smoking, and caffeine in selecting the matching characteristics. The population studied was male, with a mean age of 36 years (range of 21 to 56 years of age). Their work history was carefully verified and the possibility of peak exposures to DMF was ruled out. The workers were evaluated by means of a questionnaire of subjective complaints, medical examination, and laboratory studies, including transaminase and gamma-glutamyl transpeptidase levels. DMF-exposed workers complained more often of headache, dyspepsia, nonspecific cardiac distress, and digestive impairment indicative of hepatic functional impairment. Symptoms of respiratory irritation that were significantly increased in DMF exposed group included watery eyes, cough, and dry throat. The exposed workers also exhibited significantly increased gamma-glutamyl transpeptidase levels. Several of the exposed workers complained of a disulfiram-type reaction upon alcohol ingestion. Other indications of liver damage which were not significantly different statistically included elevated SGOT (9 in DMF group and 3 in control), elevated SGPT (12 in DMF group and 8 in controls), and enlarged liver (20 vs. 16). This study demonstrates a LOAEL for digestive disturbances and evidence suggestive of mild liver abnormalities resulting from

occupational exposure to a TWA concentration of 22 mg/cu.m DMF (LOAEL(ADJ) = 7.9 mg/cu.m). Within the DMF exposed group there was no differences between a subgroup with no dermal exposure and a subgroup with potential dermal exposure (data not presented) indicating that exposure to DMF via the dermal route was not a significant confounder.

Catenacci et al. (1984) examined hepatic function in workers exposed to low levels of DMF. They studied SGOT, SGPT, gamma-glutamyl transpeptidase, and alkaline phosphatase levels in 54 workers who had been employed in an acrylic fiber plant for more than 5 years. The workers were divided into two groups; the first group of 28 subjects was exposed to an 8-hour TWA concentration of 18 mg/cu.m (range of 12 to 25 mg/cu.m) DMF, and the second group of 26 subjects was exposed to an 8-hour TWA concentration of 3 mg/cu.m (range of 1 to 5 mg/cu.m) DMF. The duration-adjusted exposures were 6.4 and 1.1 mg/cu.m, respectively. The control group consisted of 54 workers who were never exposed to solvents. No significant difference was observed between either of the exposed groups and the controls for any of the parameters tested. Thus, based on the results of this study, an 8-hour TWA duration- adjusted concentration of 6.4 mg/cu.m can be considered a NOAEL for hepatotoxicity in humans occupationally exposed to DMF. However, the power of this study was not high enough to detect a difference in enzyme levels because only 54 matched pairs were used. Thus, if the study population was larger, statistically significant changes in indices of hepatic function may have been observed by Catenacci et al. (1984) at exposure levels comparable to those in the Cirla et al. (1984) study that were associated with significant subjective and objective hepatic effects in 100 workers.

I.B.3. Uncertainty and Modifying Factors (Inhalation RfC)

UF — An uncertainty factor of 10 is used for protection of sensitive human subpopulations. A factor of 30 is used to account for use of a LOAEL, the lack of reproductive toxicity data, and the less than chronic duration of exposure.

MF — None

I.B.4. Additional Studies/Comments (Inhalation RfC)

Several case reports and epidemiological studies indicate that the liver is adversely affected following exposure to DMF. Redlich and coworkers investigated an outbreak of liver disease in workers employed in a fabric coating factory where DMF, along with other solvents, is mixed with polyurethane and used to coat fabrics (Redlich et al., 1987a,b; 1988; Riely et al., 1988). Exposure levels were not quantified, but workers were exposed to large quantities (approximately 15 to 20 55-gallon drums per week) of DMF in poorly ventilated areas without appropriate skin protection. Average duration of employment was 40 months, but 15 workers were employed for 3 months of less. Fifty-eight of the 66 workers participated in the study.

Elevations of either aspartate aminotransferase (AST) or alanine aminotransferase (ALT) levels were observed in 36 of the 58 employees, with 19 of these workers showing increases of twice the normal values, which is indicative of liver disease. The liver enzyme levels correlated with job classification; 11 of 12 nonproduction workers had normal liver enzymes while 35 of 46 production workers had some elevation in liver enzyme levels. These changes in liver enzyme levels were verified by pathological evidence of liver disease revealed in liver biopsies taken from 7 workers. The changes seen were variable, but consisted mainly of microvesicular and macrovesicular steatosis, spotty necrosis, and evidence of diffuse regeneration. None of the biopsies showed changes indicative of alcoholism (i.e., fibrosis or cirrhosis). Furthermore, questionnaire results from 46 workers revealed the following symptoms: gastrointestinal discomfort (anorexia, abdominal pain or nausea) in 31 respondents, central nervous system solvent intoxication (headaches, dizziness) in 18, and alcohol intolerance characterized by a disulfiram type reaction (facial flushing and palpitations after alcohol intake) in 11. These results demonstrate that exposure to high levels of DMF, particularly through the skin and inhalation of vapors, can result in liver disease. These data are not sufficient to determine whether these effects are reversible or whether chronic liver disease can result from long-term exposure. Also, concurrent exposure to other solvents, including methylethylketone, toluene, 1,1,1-trichloroethane, and dichlorobenzene may have potentiated the hepatotoxicity of DMF.

Potter (1973) reported a case in which a 52-year-old man, employed in a urethane fabric coating plant that uses DMF, was splashed with DMF over 20% of his body. He washed his skin but put the same clothes back on to drive home in an enclosed car. Epigastric pain commenced 62 hours after exposure, and the patient was admitted to the hospital. His liver enzymes (SGOT, SGPT) were elevated, and he tested positive for porphobilinogenuria, but his amylase, lipase, and alkaline phosphatase levels remained normal. His symptoms gradually subsided, and he was asymptomatic upon reexamination 5 months later. Thus, acute high level exposure to DMF can result in liver injury, but the effects are apparently reversible.

Lauwerys et al. (1980) studied 22 workers who were exposed to 1 to 46.3 mg/cu.m DMF for an average of 5.3 years, and compared the results with those obtained from 28 control workers. They found no significant difference in liver function tests (transaminases, OCT, gamma-glutamyl transpeptidase, alkaline phosphatase, bilirubin) when the exposed workers were compared to the control workers. However, signs of alcohol intolerance were observed in the workers at DMF levels below 30 mg/cu.m. Similarly, Yonemoto and Suzuki (1980) found no effects on SGOT, SGPT, alkaline phosphatase, and gamma-glutamyl transpeptidase in 11 workers exposed to 3 to 15 mg/cu.m DMF, but the workers reported episodes of alcohol intolerance.

A number of additional occupational studies and case reports report the occurrence of hepatic effects in exposed workers. These studies are limited by small sample size and uncharacterized

exposure levels. For many, translations were not available, so summaries from secondary sources are discussed below. Massmann (1956a) reported that all liver function tests were normal in 24 workers exposed to DMF at levels that were generally below 10 ppm for 3 to 24 months. Reinl and Urban (1965) studied 12 workers exposed to DMF levels that were generally <20 ppm for 1 to 32 weeks and reported the occurrence of alcohol intolerance, vomiting, hepatomegaly, jaundice, urobilinuria, and elevated serum transaminases in several of these workers. No increase in serum transaminases was observed in workers exposed to an unknown concentration of DMF for 6 months (Di Lorenzo and Graziolo, 1972). Tolot et al. (1968) reported that a liver biopsy performed 3 months after an acute accidental exposure to an unspecified level of DMF showed vacuolization of the parenchymal cells. Abdominal pain, nausea and vomiting, and ethanol intolerance were observed in four workers exposed to an unknown concentration of DMF (Chary, 1974). A group of foreign studies cited by Cirla et al. (1984) also reported subjective and objective evidence for hepatic toxicity associated with DMF exposure, but all of these studies lacked adequate sample sizes, appropriate controls, and/or adequate characterization of the exposure levels (Fiorito et al., 1979; Massmann, 1967; Paoletti and Iannaccone, 1982; Taccola et al., 1981).

Although generally inadequate when considered individually, taken together, these studies demonstrate that DMF exposure is associated with hepatic toxicity in humans. Subjective evidence of liver toxicity (e.g., digestive impairment, alcohol intolerance) is often seen at exposure concentrations below those which cause elevations in serum enzymes of hepatic function, and thus, may serve as more sensitive indicators of DMF-induced hepatic toxicity. The rat and mouse subchronic study by Craig et al. (1984) demonstrates that as one moves up the concentration-effect curve, clinical evidence of liver toxicity is accompanied by histopathological evidence, as discussed below.

Craig et al. (1984) exposed 10 F344 rats/sex or 10 B6C3F1 mice/sex to either 0, 150, 300, 600, or 1200 ppm (0, 448, 897, 1794, or 3587 mg/cu.m) of DMF for 6 hours/day, 5 days/week for 12 weeks (duration-adjusted to 0, 80, 160, 320, or 641 mg/cu.m). Animals were observed for clinical signs of toxicity, body weights were determined biweekly, and complete gross necropsies were performed on all animals. Clinical chemistry analyses were performed on all animals that survived to terminal sacrifice. Histopathological evaluation was conducted on the lungs, heart, liver, thymus, spleen, pancreas, kidneys, urinary bladder, testes and nasal passages. The rats exposed to 1200 ppm showed few signs of overt toxicity, but their weight gain was significantly less than the control animals. The female rats exhibited an increase in serum alkaline phosphatase and one high-dose animal had high SGPT and SGOT levels that may be indicative of acute hepatocellular injury. Gross necropsy findings included increased discoloration of the lungs in high-dose rats, but no lesions were found in the lungs or nasal turbinates with histological examination. The only treatment-related changes occurred in the liver. These changes consisted of pale, enlarged livers with an accentuated lobular pattern and/or

prominent capsular blood vessels. Histopathology revealed that the livers of two rats that died during the study exhibited wide-spread collapse, necrosis, and accumulation of yellow-brown pigments in Kupfer cells, macrophages, and hepatocytes. The livers of the high-dose females were found to contain areas of collapse near the central veins with occasional fibrosis and yellow-brown pigment, and large variations in nuclear size and cytoplasmic characteristics. The livers of the females exposed to 300 or 600 ppm DMF showed variation in nuclear size and cytoplasmic characteristics that were similar to the higher doses but to a lesser extent. No changes were seen in the livers of rats exposed to 150 ppm DMF. Livers from the male rats exhibited the same changes as those described for the females except that there was no collapse or fibrosis. A NOAEL of 150 ppm (NOAEL[HEC] = 80 mg/cu.m based on an extrarespiratory effect, assuming periodicity was attained) is identified for these hepatic cell changes.

The mice exposed to DMF exhibited no clinical signs of toxicity, no changes in body weight gain, and no hematologic or clinical chemistry changes attributable to treatment. However, 8 high-dose mice and 3 mice exposed to 600 ppm DMF died or were sacrificed moribund during the study. The livers from the treated mice in all groups revealed collapse, necrosis, and yellow-brown pigment in the groups exposed to 600 and 1200 ppm. Hepatic cytomegaly was observed in all exposed groups and the incidence and severity of this lesion were dose-related. These results indicate a LOAEL of 150 ppm for DMF in mice (LOAEL[HEC] = 80 mg/cu.m based on an extrarespiratory effect, assuming periodicity was attained). No effects were reported in the respiratory tract.

Kennedy and Sherman (1986) exposed 10 rats to 2523 ppm DMF 6 hours/day for 5 days. Progressive weakness, discomfort, and weight loss were observed in these animals. One rat died after the second day and necropsy revealed acute pulmonary congestion and edema. An additional 7 animals that died 1 to 3 days after the final exposure exhibited dehydration and acute liver necrosis. The remaining 2 animals survived the 10-day recovery period and one of these animals exhibited evidence of healing liver injury upon necropsy.

Tanaka (1971) studied the effects of inhalation exposure to DMF on female Sprague-Dawley rats of varying ages. Measurement of liver enzyme activities and histopathology were conducted on 3-, 4-, 5-, 8-, and 12-week-old rats exposed to 200 ppm DMF (598 mg/cu.m) 8 hours/day 7 days/week for 4 weeks (duration-adjusted concentration, 199 mg/cu.m). SGPT and SGOT activities were increased in the 3- and 4-week old rats, but not in the rats that were 5 weeks or older. Serum alkaline phosphatase activity was increased in rats that were up to 5 weeks of age. Histopathological changes were observed primarily in the livers of the younger animals, including degeneration, cloudy swelling of liver cells, and isolated cases of fatty degeneration primarily in the central zone. This study identifies a LOAEL of 200 ppm for liver damage (LOAEL[HEC] = 199 mg/cu.m based on an extrarespiratory effect, assuming periodicity was attained). Tanaka (1971) also exposed groups of 3-week-old female rats to 200 ppm DMF for

either 1 or 8 hours/day every day for 4 weeks. The rats were sacrificed after 1, 2, or 4 weeks and the liver function and pathology were evaluated. SGOT and SGPT were elevated in both groups of animals. The liver damage observed in the exposed animals was qualitatively similar across both groups (degeneration with evidence of regeneration after 2 and 4 weeks of exposure), but the animals exposed to DMF for 8 hours/day showed more severe lesions. The LOAEL[HEC] for the group exposed for 1 hour/day is 25 mg/cu.m.

Massmann (1956b) exposed 2 cats and 16 rats to either 100, 230, or 450 ppm (299, 688, or 1345 mg/cu.m) DMF 8 hours/day, 6 days/week for 120 days (duration-adjusted to 85, 197, or 384 mg/cu.m). Clinical signs of toxicity, body weight, hematological parameters, and liver function were measured, as well as the electrocardiogram (in cats only). No overt signs of toxicity were noted in the rats, but the cats ate less and lost weight. No hematological changes were noted in either species, and the liver function tests were normal. Necropsy revealed an "irregular incidence" of liver necrosis in the rats, but the cats exhibited only fatty degeneration without necrosis. Other changes noted in the rats included bronchopneumonia, hyperemia of the brain, cloudy swelling of the uriniferous tubules of the kidney, and iron deposits in the spleen. Data on incidence of these effects are not included in the report, but it is implied that liver changes were noted in the cats at DMF concentrations of 100 ppm or more (LOAEL[HEC] = 85 mg/cu.m), while the rats were not adversely affected at DMF concentrations below 450 ppm. Therefore, the NOAEL in rats is 230 ppm (NOAEL[HEC] = 197 mg/cu.m).

Clayton et al. (1963) reported that rats exposed to 91 ppm (272 mg/cu.m) DMF 6 hours/day (duration-adjusted to 49 mg/cu.m) for 10 days had increased relative liver weight (LOAEL[HEC] = 49 mg/cu.m). Clayton et al. (1963) also exposed mice (11 females), rats (10/sex), guinea pigs (10 males), rabbits (2/sex), and dogs (4 males) to 23 ppm DMF for 5.5 hours/day followed by 426 ppm for 0.5 hours/day for 58 weekdays. This exposure regimen was designed to simulate peak exposures that occur in plant operations. No adverse clinical signs were seen in any species except dogs where one of the four animals had a decrease in systolic blood pressure. This dog also exhibited degenerative myocardial changes at necropsy. Increased liver weights were seen in all species except the guinea pig, but the difference was statistically significant only in mice. Plasma cholesterol levels were increased in the rats, rabbits, and in the single dog that demonstrated cardiovascular changes. Rat liver fat content was also increased. A LOAEL of 56.6 ppm is calculated as a TWA concentration for a 6-hour exposure (LOAEL[HEC] = 30.2 mg/cu.m).

The only information on the reproductive effects of DMF in humans was reported by Farquharson et al. (1983). They described the occurrence of three unexplained cases of small-for-date third trimester intrauterine deaths in women quality control analysts working in the pharmaceutical industry. This represents a 30% stillbirth rate as compared with the average for the general population of that area of 0.26%. The authors concluded that this occurrence was not

likely due to chance, but cannot be attributed solely to DMF because these women were exposed to other agents in addition to DMF.

An extensive database exists on the developmental toxicity of DMF in animals following inhalation, oral, dermal, or intraperitoneal exposure. Taken together, the available information indicates that DMF is embryotoxic, but does not usually produce teratogenic effects (e.g., BASF, 1974a,b,c; BioDynamics, 1978; Kimmerle and Machemer, 1975). The available inhalation developmental toxicity studies on DMF are summarized as follows:

Kimmerle and Machemer (1975) reported that exposure of 22 or 23 female rats to 18 or 172 ppm (54 or 514 mg/cu.m) DMF 6 hours/day on gestation days 6 to 15 produced no evidence of maternal toxicity or fetal malformations. However, fetal body weight was significantly reduced in the high-dose group as compared with the controls, suggesting a LOAEL at 172 ppm (LOAEL[HEC] = 514 mg/cu.m) and a NOAEL at 18 ppm (NOAEL[HEC] = 54 mg/cu.m).

In a series of unpublished experiments conducted by BASF (1974a,b,c), pregnant rats were exposed to either 220 or 520 ppm (660 or 1554 mg/cu.m) DMF on gestation days 4 to 8, or 287 ppm (858 mg/cu.m) DMF on gestation days 0 to 1, 4 to 8, 11 to 15, and 18 to 19, or 0 to 3, 6 to 10, and 13 to 18. Despite that unorthodox nature of the exposure regimen, similar results were obtained in all three experiments. A significant reduction in maternal weight gain was observed in all animals (except those exposed to 220 ppm DMF), and a reduction in fetal weight and length was observed in all groups. The mean number of live fetuses was lower in animals exposed to 287 or 520 ppm. The authors report that there was "an increased number of retardations and variations" found in the offspring of animals exposed to 287 or 520 ppm DMF, but these effects were not evident in the data presented. This series identifies a LOAEL for a reduction in fetal weight and length at 220 ppm (LOAEL[HEC] = 660 mg/cu.m).

Similar results were reported in an unpublished study by BioDynamics (1978). Pregnant Sprague-Dawley rats (21/group) were exposed to 30 or 300 ppm (90 or 900 mg/cu.m) DMF on days 6 to 15 of gestation. A significant reduction in implantations and fetuses was observed in the dams exposed to 30 ppm DMF. Since the resorption rate was not significantly increased, the authors concluded that the reduction in the number of fetuses in this group could be attributed to an unexplainable decrease in both ovulation and implantation rates. Reduced maternal weight gain, lower fetal weights and a higher incidence of fetuses with ossification variations was observed in the 300-ppm group. The LOAEL for maternal and developmental toxicity is 300-ppm (LOAEL[HEC] = 900 mg/cu.m) and the NOAEL is 30 ppm (NOAEL[HEC] = 90 mg/cu.m).

Rabbits appear to be more sensitive to the toxic effects of DMF. Praetorius (1989) reported in a letter to EPA that rabbits exposed to 0, 50, 150, and 450 ppm (149, 448, and 1345 mg/cu.m)

DMF 8 hours/day on days 7 to 19 post-insemination exhibited reduced body weight or body weight gain at the two higher concentrations. Embryo/fetotoxicity was noted at the highest concentration, as evidenced by an increased number of malformations (hernia umbilicalis) and variations (mainly skeletal). One hernia umbilicalis and a slightly increased number of variations were observed in the 150 ppm group. No effects were seen in the animals exposed to 50 ppm. The LOAEL for developmental toxicity with maternal toxicity (reduced body weight or body weight gain) is 150 ppm (LOAEL[HEC] = 448 mg/cu.m) and the NOAEL is 50 ppm (NOAEL[HEC] = 150 mg/cu.m).

I.B.5. Confidence in the Inhalation RfC

Study — Medium
Database — Medium
RfC — Medium

The occupational study by Cirla et al. (1984) is a human study with the lowest LOAEL(HEC), the exposed population was large (n=100), well defined, and compared with a carefully selected referent control group. Because the exposure concentrations are not well characterized and the exposure duration is relatively short, the study is given a medium confidence rating. The database is given medium confidence because although there are several inhalation developmental toxicity studies, there are no reproductive toxicity data. Medium confidence in the RfC follows.

I.B.6. EPA Documentation and Review of the Inhalation RfC

Source Document — This assessment is not presented in any existing U.S. EPA document.

Other EPA Documentation — U.S. EPA, 1986.

Agency Work Group Review — 08/23/1990

Verification Date — 08/23/1990

Screening-Level Literature Review Findings — A screening-level review conducted by an EPA contractor of the more recent toxicology literature pertinent to the RfC for N,N-Dimethylformamide conducted in September 2002 identified one or more significant new studies. IRIS users may request the references for those studies from the IRIS Hotline at hotline.iris@epa.gov or (202)566-1676.

I.B.7. EPA Contacts (Inhalation RfC)

Please contact the IRIS Hotline for all questions concerning this assessment or IRIS, in general, at (202)566-1676 (phone), (202)566-1749 (FAX) or hotline.iris@epa.gov (internet address).

II. Carcinogenicity Assessment for Lifetime Exposure

Substance Name — N,N-Dimethylformamide
CASRN — 68-12-2

This substance/agent has not undergone a complete evaluation and determination under US EPA's IRIS program for evidence of human carcinogenic potential.

VI. Bibliography

Substance Name — N,N-Dimethylformamide
CASRN — 68-12-2

VI.A. Oral RfD References

None

VI.B. Inhalation RfC References

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VI.C. Carcinogenicity Assessment References

None

VII. Revision History

Substance Name — N,N-Dimethylformamide
CASRN — 68-12-2

Date	Section	Description
10/01/1990	I.B.	Inhalation RfC summary on-line
12/03/2002	I.B.6.	Screening-Level Literature Review Findings message has been added.

VIII. Synonyms

Substance Name — N,N-Dimethylformamide
CASRN — 68-12-2
Last Revised — 10/01/1990

- 123-31-9
- 68-12-2
- CASWELL NO. 366A
- DIMETHYLAMID KYSELINY MRAVENCI [CZECH]
- DIMETHYLFORMAMID [GERMAN]
- DIMETHYL FORMAMIDE
- DIMETHYLFORMAMIDE
- DIMETILFORMAMIDE [ITALIAN]
- DIMETYLFORMAMIDU [CZECH]
- DMF
- DMF [AMIDE]
- DMFA
- DWUMETYLOFORMAMID [POLISH]
- EPA PESTICIDE CHEMICAL CODE 366200
- FORMAMIDE, N,N-DIMETHYL-
- HSDB 78
- NCI-C60913
- N-FORMYLDIMETHYLAMINE
- N,N-DIMETHYL FORMAMIDE
- N,N-DIMETHYLFORMAMIDE
- N,N-DIMETHYLMETHANAMIDE
- N,N-DIMETILFORMAMIDA [SPANISH]
- NSC 5356
- U-4224
- UN 2265