



1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: ALUMINIUM WELDING WIRES AND RODS or ALUMINIUM BASED WELDING RODS & ELECTRODES

Product Brands: LINDE

Product Specification: AWS SFA 5.10

Product Classification/Codes: ER 4043, R4043, ER5356, R5356

Recommended use: Gas Metal Arc, Gas Tungsten Arc, and Oxy Fuel Gas welding of Aluminium

Manufacturer/Supplier: LINDE CANADA LIMITED

Address: 5860, Chedworth Way, Mississauga, Ontario, Canada, L5R 0A2

Telephone number: Customer Service Centre: 1-866-385-5349

Emergency Telephone number (24 hour): (905) 501-0802 or CHEMTREC (800) 424-9300

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2. HAZARD IDENTIFICATION

There are no recognised hazards associated directly with these unused welding consumables prior to welding. This product is considered to be a stable mixture in the physical state in which it is placed on the market.

Packaged consumables may be heavy, and should be handled and stored with care. FOLLOW MANUAL HANDLING REGULATIONS.

Some low levels of dust may be produced during handling. DO NOT BREATHE THE DUST.

When using these wires and rods as part of the welding process additional potential hazards are likely. These are:

- Electric shock from the welding equipment or electrode. This can be fatal.
- Hot metal spatter and heat from the electric arc and the welding flame, which can cause burns to the hand and body, and may cause fire if in contact with combustible materials.
- UV, IR and light radiation from the arc, which can produce 'arc eye' and possible eye damage to unprotected eyes. WEAR SUITABLE PROTECTIVE EQUIPMENT.
- Fumes produced from the welding consumable, material being welded, and the arc radiation and the welding flame. These consist of:
 - Particulate fume such as complex metal oxides and silicates from the weld materials. (Details of the fume constituents are given in section 8 of this document).
- Gaseous fume such as ozone and nitrogen oxides from the action of arc radiation on the atmosphere, and carbon monoxide and dioxide from oxidation of carbon in the components, and from the flame combustion products.
 - May cause allergy or asthma symptoms or breathing difficulties if inhaled
 - May cause respiratory irritation

SHORT TERM INHALATION OF THESE FUMES AND GASES MAY LEAD TO IRRITATION OF THE NOSE, THROAT AND EYES.

LONG TERM OVEREXPOSURE OR INHALATION OF HIGH LEVELS OF FUME MAY RESULT IN HARMFUL EFFECTS TO THE RESPIRATORY SYSTEM, CENTRAL NERVOUS SYSTEM AND LUNGS.

LOCAL EXTRACTION AND /OR VENTILATION SHOULD BE USED TO ENSURE THAT ALL HAZARDOUS INGREDIENTS IN THE FUME ARE KEPT BELOW THEIR INDIVIDUAL OCCUPATIONAL EXPOSURE STANDARDS IN THE WELDER'S AND OTHER WORKERS' BREATHING ZONES.



Fume collected in extraction systems may consist of metal compounds and should be recycled if possible.

NOTE: If welding is performed on plated or coated materials, excessive fume may be produced which contains additional hazardous components, and may result in metal fume fever and other health effects.

3. COMPOSITION/INFORMATION ON INGREDIENTS

These products consist of a solid aluminium alloys wire, either continuously wound on reels, spools or in bulk packs, or supplied in straight cut lengths. The composition of the alloys varies depending on the classification.

Details of the composition of the wire and rod consumables covered by this data sheet are given below.

TABLE 1: APPROXIMATE COMPOSITION OF CONSUMABLES (WT %)¹

AWS Specification	Aluminum Al CAS Number 7429-90-5	Silicium Si CAS Number 7440-21-3	Iron Fe CAS Number 7439-89-6	Copper Cu CAS Number 7440-50-8	Manganese Mn CAS Number 7439-96-5	Magnesium Mg CAS Number 7439-95-4	Chromium Cr CAS Number 7440-47-3	Vanadium V CAS Number 7440-62-2	Titanium Ti CAS Number 7440-32-6	Zinc Zn CAS Number 7440-66-6
A5.10/R4043	80.0-99.7	4.5-6.0	0.8	0.30	0.05	0.05	N/Av	0.10	0.20	N/Av
A5.10/R5356	Bal. As above	0.25	0.4	0.1	0.05-0.20	4.5-5.5	0.05-0.20	0.10	0.06-0.20	N/Av
A5.10 / others	Bal. As above	14.0	1.0	0.5	2.0	6.0	0.50	0.50	0.50	0.50
LD ₅₀ (specie, route)	N/Av	3160 mg/kg (rat,oral)	30 g/kg (rat,oral)	413 mg/kg (mouse, oral)	9 g/kg (rat,oral)	N/Av	N/Av	N/Av	N/Av	N/Av
LC ₅₀ (specie)	N/Av	N/Av	N/Av	N/Av	N/Av	N/Av	N/Av	N/Av	N/Av	N/Av

¹Single values indicate maximum allowed. May also contain traces of Beryllium, Lead and Nickel.

4. FIRST AID MEASURES

No first aid measures should be required for the unused wire and rod consumables. During welding:

Inhalation

If inhaled remove patient to fresh air and keep at rest in a position comfortable for breathing. If exposed or concerned call a doctor.

For skin contact / burns

Submerge affected area in cold water until burning sensation ceases and refer for immediate medical attention.

For eye effects such as arc eye and dusts

Irrigate eye with sterile water, cover with damp dressing and refer for immediate medical attention if irritation persists. If on skin immediately wash with water, Get medical attention for skin irritation.

Ingestion

Ingestion is considered unlikely due to product form. However, if detached flux coating is swallowed do not induce vomiting. Seek medical attention. Advice to doctor: treat symptomatically. Rinse mouth.



Electric shock

If necessary resuscitate and seek immediate medical attention.

5. FIRE FIGHTING MEASURES

Fire hazards/conditions of flammability

No specific measures required for the welding consumable prior to welding.

During welding

Welding should not be carried out in the presence of flammable materials, vapours, tanks, cisterns and pipes and other containers which have held flammable substances unless these have been checked and certified safe.

Suitable extinguishing media

Carbon dioxide, dry chemical powder and appropriate foam for surrounding products.

Special fire-fighting procedures/equipment

During a fire, irritating/toxic smoke and fumes may be generated. Do not enter fire area without proper protection. Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece. Shield personnel to protect from venting, rupturing or bursting cans. Move containers from fire area if it can be done without risk. Water spray may be useful in cooling equipment and cans exposed to heat and flame.

Hazardous combustion products

Carbon oxides and other irritating/toxic fumes and smoke.

6. ACCIDENTAL RELEASE MEASURES

No specific actions for these welding consumable prior to use. See sections 12 and 13 for ecological considerations.

Welding in proximity to stored or used halogenated solvents may produce toxic and irritant gases. Prohibit welding in areas where these solvents are used.

7. HANDLING AND STORAGE (FOR SAFETY)

No special precautions are required for these welding consumables.

Welding wires and rods are dense materials and can give rise to a handling hazard when reels, spools, bulk packs or multiple packages are lifted or handled incorrectly or with poor lifting posture. Gloves should be worn.

Good practice for handling and storage should be adopted to prevent physical injuries.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

Exposure Prevention

Welders should not touch live electrical parts, and should insulate themselves from the work and the ground. Manufacturer's guidelines for the use of electrical welding machines should be observed at all times.

Welders and co-workers should be educated about the health hazards associated with welding fume, and trained to keep their heads out of the fume plume. Do not breathe the dust or fume.

During welding, fumes and gases will be produced and emitted from the welding process. The content of the fume is dependent on the electrode type, shielding gas, base materials being welded and surface coatings. The amount and concentration of fume generated also depends on factors such as current,

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voltage, welding practices and number of welders in a given area. Follow recommended welding practices to minimise fume production. Do not eat, drink or smoke when using this product.

For the solid aluminium wires and rods covered by this data sheet, the main constituents of the fume will be aluminium, manganese, magnesium and copper oxides and silicates, mainly in the form of complex compounds. There will also be smaller amounts of other complex metal oxides and silicates.

Gaseous ozone and nitrous oxides are also formed by arc radiation, and carbon monoxide and carbon dioxide can also be present due to oxidation of carbon in the components, and from the flame combustion products. In some cases ozone levels can be high, and additional controls may be needed. The shielding gas if used, will also affect the fume formation rate, and higher levels of particulate fume will be generated as the percentage of argon is increase in the shielding gas with some alloys.

Typical fume composition data for the main solid aluminium wires and rods are given below.

Fume exposure should be controlled to below the recognised exposure limit for each of the individual constituents.

TABLE 2: TYPICAL FUME COMPOSITION DATA (WT%)

Classification	Al	Fe	Mn	Cr	Cu	Mg	V
4043	Bal.	1-3	<1	<1	<1	<1	<1
5356	Bal.	<1	<1	<1	<1	1.5-3.5	<1
Others	Bal.	<1*	0-10*	<1*	0-5*	1-5*	<1*

* indicates estimate, based on consumable composition

Additional fume composition data for a solid aluminium wires to AWS 5.10 R 4043 and R 5356, welded using GMAW process, with different shielding gases, are also given below, and the individual exposure limits for the constituents, (when specified) are also given.

TABLE 3:

Particulate fume composition for a range of shielding gases and AWS 5.10 R 4043 type wire using GMAW.³

Shielding Gas to ISO 14175-2008	Fe %	Mn %	Cr%	Mg%	Si %	Al and others %
MI1 (100%Ar)	0.11	<0.01	<0.01	0.16	1.56	Balance
MI3 (50% Ar)	0.04	0.06	<0.01	0.23	1.88	Balance
MI3 (25% Ar)	0.08	0.07	0.01	0.34	2.06	Balance

Weight %

Particulate fume composition for a range of shielding gases and AWS 5.10 R 5356 type wire using GMAW.³

Shielding Gas to ISO 14175-2008	Fe %	Mn %	Cr%	Mg%	Si %	Al and others %
MI1 (100%Ar)	0.09	0.08	0.05	7.67	<0.1	Balance
MI3 (50% Ar)	0.08	0.06	0.06	4.51	<0.1	Balance
MI3 (25% Ar)	0.04	0.10	0.04	4.00	<0.1	Balance

³Weight %

Note - The disclosed ranges of concentration do not fall entirely within a range of concentration set out in Section 11 of the Controlled Product Regulations in Canada.



TABLE 4: HAZARDOUS FUME COMPONENTS

Welding fume component	CAS No.	TVL- TWA	TLV-STEL	OTHER
Aluminium Oxides	1344-28-1	1 mg/m ³ (Inhalable fraction)	N/Av	N/Av
Total inhalable dust				
Respirable dust				
Iron oxide fume (as Fe)	1309-37-1	5 mg/m ³ Respirable particulate mass	N/Av	N/Av
Manganese and its inorganic compounds (as Mn)	7439-96-5	0.2 mg/m ³	N/Av	N/Av
Silica, amorphous (total inhalable dust) (respirable dust)	N/Av	N/Av	N/Av	10 mg/m ³ 3 mg/m ³
Magnesium oxide (as Mg)	1309-48-4	10 mg/m ³ (Inhalable fraction)	N/Av	N/Av
Total inhalable dust				
Respirable dust				
Copper, fume	7440-50-8	0.2 mg/m ³ (fume)	N/Av	N/Av
Zinc oxide, fume	1314-13-2	2 mg/m ³ (Inhalable fraction)	10 mg/m ³ (Inhalable fraction)	N/Av
Carbon Dioxide	124-38-9	5000 ppm	30000 ppm	N/Av
Carbon Monoxide	630-08-0	25 ppm	N/Av	N/Av
Nitrogen dioxide (NO ₂)	10102-44-0	3 ppm	5 ppm	N/Av
Ozone (O ₃)	10028-15-6	*	N/Av	N/Av
Nitrogen monoxide (NO)	10102-43-9	25 ppm	N/Av	N/Av

Note – Only ACGIH are listed in this table. Other ACGIH TVL values: Chromium TLV-TWA is 0.5 mg/m³; Copper TLV-TWA is 1 mg/m³(dust, mist).

* Heavy work 0.05 ppm; Moderate work 0.08 ppm; Light work 0.1 ppm; For two hours or less exposure time, heavy/moderate/light work loads 0.2 ppm.

The fume analyses for the solid aluminium wires and rods covered by this data sheet, and used for welding clean, uncoated aluminium indicate that as long as the total fume exposure limits are met, fume levels of the other constituents will generally be below their respective exposure limits. Do not weld until all safety precautions have been read and understood.

The exceptions are manganese, ozone and nitrogen dioxide (when electric arc welding), and carbon monoxide (when gas welding). These all have low exposure limits and additional controls may be required.

THE FUME LEVELS GIVEN ABOVE WERE GENERATED UNDER LABORATORY CONDITIONS WHEN WELDING CLEAN, PLAIN UNCOATED ALUMINIUM UNDER THE MANUFACTURERS RECOMMENDED WELDING PARAMETERS, AND ARE INDICATIVE OF REASONABLY EXPECTED FUME LEVELS. ACTUAL FUME LEVELS WILL VARY IN PRACTICE, DEPENDING ON THE WELDING PARAMETERS AND OTHER CONDITIONS, AND MAY BE HIGHER OR LOWER THAN THOSE LISTED ABOVE.

ADDITIONAL FUME MAY ARISE WHEN THESE WIRES AND RODS ARE USED TO WELD CONTAMINATED BASE MATERIALS, COATED OR PLATED MATERIALS, OTHER METALS AND ALLOYS, OR WHEN INCORRECT WELDING CONDITIONS ARE USED.

THE ONLY ACCURATE WAY TO DETERMINE THE COMPOSITION AND QUANTITY OF FUMES AND GASES TO WHICH WORKERS ARE EXPOSED IS TO TAKE AIR SAMPLES FROM INSIDE THE WELDERS HELMET, IF WORN, OR IN THE WORKER'S BREATHING ZONES.



Individual fume measurements should be made in these cases using recognised sampling and analysis standards. Based on the results of these measurements, additional fume controls may be required to ensure that all the fume constituents are controlled below their exposure limits.

Controls

Good general ventilation, and/or local fume extraction at the arc or flame should be used to control the fumes and gases produced during welding to below their individual recognised exposure limits when measured in the welder's and co-workers' breathing zone. In addition the ventilation and extraction should also be sufficient to ensure that the total particulate fume levels are reduced when measured in the breathing zone. Use only in well ventilated areas. Avoid breathing dust, fume and gas. Get medical attention if you feel unwell.

In confined spaces where ventilation is not adequate, an air fed breathing system should be used. All precautions for working in confined space should be observed.

Where fume levels exceed the recognised exposure limits, wear respiratory protection in the form of a Class P2 (metal fume) respirator.

Personal Protection

Welders and co-workers in the vicinity should wear protective gloves, protective clothing and eye protection and face protection appropriate to the welding process being used, as specified by local standards.

Protection of Body and Skin

Suitable clothes for welding should be worn such as non light reflective fire-resistant clothing, overalls, leather apron, welding helmet (for arc welding), suitable head protection and welding goggles (for gas welding), leather boots spats and gloves.

Protection of Hands

Welders should wear suitable hand protection such a welding gloves or gauntlets of a suitable standard. Co-workers should also wear suitable hand protection against hot metal, sparks and spatter.

Eye Protection

As appropriate for the welding process being used, welders should wear a welding helmet or welding goggles fitted with the correct optical welding filter for the operation. Suitable protective welding screens and goggles should be provided, (e.g. ANSI Z87.1/AWS F2.2) and used by others working in the same area.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Solid

Colour: Generally white metallic or light grey

Form: Metal wire or rods

Odour: Odourless

Odour threshold: Not Available

Flash point (method): Not Applicable

Lower and Upper flammable limits (% by volume): Not Applicable

Sensitivity to mechanical impact/static discharge: Not Applicable

PH: Not available

Vapour pressure: Not Applicable

Vapour Density: Not Applicable



Boiling point / range: Not Applicable

Melting Point: ~700°C

Solubility in water: Insoluble

Density: Not Available

Explosive / ignition point: Non-flammable. No fire or explosion hazard exists.

Coefficient of oil/water distribution: Not Applicable

10. STABILITY AND REACTIVITY

There are no stability or reactivity hazards from welding wires or rods as supplied. Stable under the recommended storage and handling conditions prescribed. Hazardous polymerization will not occur. Incompatible materials and conditions to avoid are usually related to welding.

Hazardous decomposition products such as metal oxide fumes and gases (see Section 8) are produced during welding.

11. TOXICOLOGICAL INFORMATION

Inhaling welding fumes can be dangerous to your health. Welding fumes contain various particles and gases produced by the welding process. The International Agency for Research on Cancer has classified welding fumes as possibly carcinogenic to humans.

Welding fumes may irritate the nose, throat and eyes and may aggravate pre-existing respiratory problems such as asthma, emphysema or chronic bronchitis. Exposure to excessive concentrations of welding fumes may also lead to metal fume fever, dizziness, nausea, skin irritation, or impairment of pulmonary function, and possibly neurological injury. The potential health effects from welding fumes depends on the consumable, base material, surface coatings, air contamination, welding process, ventilation, and use, if necessary, of respirators and exhaust equipment. Consult with the specific toxicity data below to assess the health risk when using any particular welding process. See also the additional information below regarding the potential health effects of specific fume components.

Unprotected skin exposed to UV and IR radiation from the welding arc may burn or redden, and UV radiation is potentially a carcinogen. UV radiation can affect the unprotected eye by producing an acute condition known as 'arc eye'.

Specific effects relevant to major particulate and gaseous fume constituents produced when welding with these wires and rods include:

Aluminium

Aluminium has been associated with respiratory effects, notably a type of lung pneumoconiosis named 'Shaver's disease'. Its ability to induce neurological symptoms has led to the suggestion that it may be a cause of Alzheimer's disease. An association between any of these effects and welding fume exposure is unproven.

Iron

The chief component of fume generated by welding carbon steels is iron oxide. Iron oxide is generally considered only a nuisance material, but the fume particles can accumulate in the lungs and lead to a benign pneumoconiosis called siderosis.

Manganese

Manganese compounds are also found in welding fumes. Sustained exposure to manganese or manganese compounds above applicable limits can cause manganism, a form of irreversible brain damage. The symptoms of manganism may include tremors, slurred speech, impaired movement, spastic gait, lethargy, muscular weakness and psychological disturbances. Persons who believe they may have been overexposed to manganese compounds should consult a physician.



Chronic exposure to manganese at levels below that required to produce manganism may lead to impaired reproductive function in men. It has been reported that chronic exposure to manganese at levels below that required to produce manganism may lead to cognitive and neurobehavioural deficits. Respiratory symptoms may result from acute exposure to high concentrations or chronic low level exposure.

Silica

Silica is found in welding fumes produced by copper alloy wires and rods, and is produced mainly as amorphous silica. Inhalation of this form of silica at high concentrations may lead to lung inflammation but has not been associated to any significant degree with lung pneumoconiosis which is associated with crystalline forms of silica.

Chromium

Chromium can exist in differing forms in welding fumes and this can determine the potential health effects. The most toxic form of chromium is hexavalent chromium (Cr6+) which is classified as a human carcinogen. The other main form of chromium found in welding fumes, trivalent chromium (Cr3+), is considerably less toxic and is not classified as a carcinogen. Both types of chromium are found in the fume from this product.

Hexavalent chromium is genotoxic and exposure is associated with lung, nasal and sinus cancer. It can produce respiratory tract effects including nasal ulceration and lung diseases. It can also cause sensitisation, resulting in allergic contact dermatitis and possibly asthma; irritation of the nose, lungs, skin and eyes; and can have adverse effects on the blood, kidneys and reproductive system. Trivalent chromium affects the respiratory system and can cause skin sensitisation.

Copper and Zinc

Copper may be implicated as a cause of metal fume fever observed during welding. Zinc in welding fume is the main cause of metal fume fever observed after acute exposure to high levels during welding. Metal fume fever is a delayed respiratory effect with symptoms including sweating, chills, fever, muscle aches and high temperature. These acute symptoms normally alleviate within 24-48 hours. Such exposure to zinc may also result in gastrointestinal symptoms such as nausea.

Ozone and Nitrogen oxides

These gases are formed due to interactions of the arc with the surrounding air. Ozone, nitrogen dioxide and nitric oxide can irritate the eyes, and respiratory tract including the lungs. They can also produce longer term lung effects such as decreased lung function, possibly chronic bronchitis, and (for nitrogen dioxide) emphysema. Of particular concern with these gases is that acute exposure to high levels (e.g. due to build up in confined spaces) can result in severe lung effects such as delayed pulmonary oedema. Ozone may be genotoxic and/or carcinogenic. Nitrous oxide is used as an anaesthetic, so clearly it affects the central nervous system, and it can also affect the peripheral nervous system. Nitrous and nitric oxide can have adverse effects on the blood.

Carbon monoxide and carbon dioxide

These gases are mainly formed through decomposition of some electrodes' components, or from oxidation of any carbon in the wires and rods, or from the shielding gas.

Carbon monoxide (CO) is a chemical asphyxiant that binds to blood haemoglobin, reducing the blood's oxygen-transport capacity. High exposures can cause fatigue, weakness, dizziness, loss of consciousness and, eventually, even death. At lower levels, exposure to carbon monoxide may lead to toxicity in the respiratory, cardiovascular and central nervous systems.

Carbon dioxide (CO₂) is mainly a simple asphyxiant. At low levels of exposure, pulse and heart rate may increase, followed by respiratory and heart effects at higher concentrations, and ultimately unconsciousness and death.

Synergistic materials

Not Available



12. ECOLOGICAL INFORMATION

The welding process produces particulate fumes and gases which may cause long term adverse effects in the environment if released directly into the atmosphere. Welding fumes from the normal use of the aluminium wires and rods covered by this data sheet can produce carbon dioxide gas, which is dangerous to the ozone layer.

Fume collected from welding operations should not be allowed to leach into groundwater or collect in soil.

13. DISPOSAL CONSIDERATIONS

Packaging and wire/rod scrap should be disposed of as general waste or recycled. No special precautions are required for this product. Fume collected from extraction units should be disposed of in accordance with local regulations (including Provincial and Federal Regulations). Collect all spillage.

14. TRANSPORT INFORMATION

No special requirements are necessary in transporting these products.

Transportation of Dangerous Goods Regulations (TDGR):

TDG Classification: NOT REGULATED

Special case: N/Ap

15. REGULATORY INFORMATION

WHMIS Label Information: **WARNING.** Do not remove or cover this Warning. Protect yourself and others. Read and understand this information. Electric shock can kill. Keep your head out of the fume. Arc rays and fume can affect others in your workplace. Comply with your employer's safety practices and procedures: protect others.

Safety data sheet available on request from www.lindecana.com.

WHMIS information: Product is regulated according to the Controlled Product Regulations (CPR) in Canada. This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and this MSDS contains all the information required by the CPR.

WHMIS classification: D2A - Toxic Material with other effects.

16. OTHER INFORMATION

The customer should provide this Safety Data Sheet to any person involved in the materials use or further distribution. The Linde Group requests the users (or distributors) of this product to read this Safety Data Sheet carefully before usage.

Prepared by **LINDE CANADA LIMITED**

References

Material Safety Data Sheets from manufacturer/supplier.

Canadian Centre for Occupational Health and Safety, CCIInfoWeb databases, 2010.

Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
CAS	Chemical Abstract Service
IARC	International Agency for Research on Cancer
LC	Lethal concentration
LD	Lethal Dosage
N/Ap	Not applicable
N/Av	Not available
NIOSH	National Institute for Occupational Safety and Health
STEL	Short-term Exposure Limit

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TLV Threshold Limit Value
TWA Time Weighted Average
WHMIS Workplace Hazardous Materials Information System

The information contained in this Safety Data Sheet relates only to the specific materials designated and may not be valid for such material used in combination with any other material or in any process.

Information is given in good faith and is based on the latest information available to The Linde Group and is, to the best of The Linde Group's knowledge and belief, accurate and reliable at the time of preparation. However, no representation, warranty or guarantee is made as to the accuracy, reliability or completeness of the information, and The Linde Group assumes no responsibility and disclaims any liability incurred in using this information.

The product is supplied on the condition that the user accepts the responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. Freedom from patent rights must not be assumed.