CBRN APR User Guide
Training Aid

February 2006

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Foreword

This training aid is an educational tool created to enhance the safety and health of responders using air-purifying respirators (APR) approved with chemical, biological, radiological, and nuclear (CBRN) protection by the National Institute for Occupational Safety and Health (NIOSH). This training aid is a companion document to the comprehensive *NIOSH CBRN APR User's Guide** and summarizes key topics which are more fully explained in detail in that publication. This training aid should not be viewed as a complete CBRN APR training guide, but rather as a reference tool for individuals who have received training from the *NIOSH CBRN APR Guide**. Both publications should serve as complements to, not substitutes for, a required respiratory protection program. The purpose of the *NIOSH CBRN APR User's Guide** is to educate individual respirator wearers, incident commanders, and team leaders, about the selection, operation, protections, and cautions and limitations of CBRN APR approved by NIOSH. A list of NIOSH-approved CBRN APR is available on the NIOSH website at: http://www.cdc.gov/niosh/npptl/topics/respirators/cbrnapproved/apr/#list

For more information about NIOSH-approved respirators and respirator use guidelines call 1-800-35-NIOSH.

Director, National Institute for Occupational Safety and Health
Centers for Disease Control and Prevention

** Guide to the Technical Use of Chemical, Biological, Radiological, Nuclear (CBRN), Full Facepiece, Air-Purifying Respirators (APR) /Gas Masks Certified Under 42 CFR Part 84. DHHS Publication No. ———*

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Introduction

The CBRN APR is a full facepiece, non-powered, tight-fitting respirator, which uses an air-purifying canister to remove particulates, gases, and vapors from the air. This training aid provides an overview of NIOSH recommendations for CBRN APR use. This training aid should not be viewed as a complete CBRN APR training guide, but rather as a reference tool for individuals who have received training from the *NIOSH CBRN APR Guide**. Both publications should serve as complements to, not substitutes for, a required respiratory protection program.

This training aid provides guidance on the protections provided by the respirator, how to select the canister capacity level (also called the "Cap" level), and guidance for establishing a canister change schedule. Additionally explained is the time-use limitation called "CBRN respirator use life" (CRUL) which restricts the time the entire APR system can be used in a chemical warfare agent (nerve or blister agent) environment. The unique protective qualities of the canister permit 'dual purpose' use, meaning the APR can be used effectively for both a response to an act of terrorism, and for industrial use (for example, work at manufacturing worksites, natural disaster sites, and health care facilities) to protect against a wide range of chemical, biological, radiological, and nuclear respiratory hazards.

The information in the *NIOSH CBRN APR Guide** and this companion training aid is intended to be administered through a complete respiratory protection program. The effective and safe use of the CBRN APR relies on the user receiving comprehensive training on both NIOSH guidance and the respirator manufacturer's use recommendations. The Occupational Safety and Health Administration (OSHA) requires those parts of industry and government that fall within their jurisdiction to follow the program requirements of the OSHA Respiratory Protection Standard [29 CFR 1910.134] when respiratory protection is determined necessary by the employer. Such a respirator protection program covers criteria for selecting respirators; medical evaluations; fit testing; use criteria; maintenance, inspection, cleaning, and storage; worker training; and regular evaluations of program effectiveness. The respiratory protection program is also required to be directed by a designated knowledgeable professional, the respirator program administrator. The respirator program administrator oversees all aspects of the respirator program, interacts with management personnel and is available to the user as a resource for questions or concerns on respirator use.

Information on the OSHA Respiratory Protection Standard [29 CFR 1910.134] is available at: http://www.osha.gov/SLTC/etools/respiratory/index.html

** Guide to the Technical Use of Chemical, Biological, Radiological, Nuclear (CBRN), Full Facepiece, Air-Purifying Respirators (APR) /Gas Masks Certified Under 42 CFR Part 84. DHHS Publication No. ———*

Step 1 – Overview of NIOSH-approved Use

WARNING: ----- Use of a CBRN APR which is not in accordance with both NIOSH recommendations and the manufacturer's user's instructions may result in serious injury, sickness, or death.

The NIOSH-approved CBRN APR is only recommended for use when *ALL* of the following criteria are met:

- The types of inhalation hazards and their concentrations have been identified.
    - *In response to a CBRN exposure event, emergency first responders should use NIOSH approved CBRN self-contained breathing apparatus (SCBA) respirators when the types of inhalation hazards and their concentrations are unknown or expected to be high. The CBRN APR full facepiece respirator provides a lower level of protection than the SCBA and its use is generally allowed once conditions are understood and exposures are determined to be at lower levels.*
- The CBRN APR canister is capable of filtering the identified chemical.
    - *The CBRN canister provides protection against a wide range of gas, vapor, and particulate hazards, but does not filter all types of gases and vapors. See Step 7 for a description of hazards the canister is capable of filtering.*
- Oxygen concentration is known to be at least 19.5% by volume.
    - *Monitor ambient oxygen concentration to determine that the atmosphere is not oxygen deficient*[1].
- The contaminant concentration is less than the immediately dangerous to life or health (IDLH) limit for the particular hazard.
    - *Air-purifying respirators are not approved for use at or above IDLH concentrations. The 2005 NIOSH Pocket Guide to Chemical Hazards lists IDLH values established by NIOSH for many chemicals.*

[1] NIOSH defines an oxygen-deficient atmosphere as an atmosphere which contains an oxygen partial pressure of less than 148 millimeters of mercury (19.5 percent by volume at sea level) (NIOSH 2005).

- The contaminant concentration is less than the maximum use concentration (MUC) of the respirator.[2]
    - *The maximum use concentration (MUC) for the CBRN APR is the maximum atmospheric concentration of a hazardous substance for which an employee can be expected to be protected*
- A canister change schedule has been developed if the contaminant is a gas or vapor.
    - *Canisters have a limited amount of time they can be used before they need to be changed. See Step 9 for guidance on establishing a canister change schedule.*
- The user has received a fit test prior to being assigned a respirator.
    - *Under the OSHA Respiratory Protection Standard (29 CFR 1910.134), fit-testing must be performed initially (before the employee is required to wear the respirator in the workplace) and must be repeated at least annually. Fit-testing must also be conducted whenever respirator design or facial changes occur that could affect the proper fit of the respirator.*
- The user has received complete training on the operational use, protections, and limitations of their unique CBRN APR system.
    - *CBRN APR training should include complete respirator training program requirements (such as the ones required by OSHA in 29 CFR 1910.134) including the individual manufacturer's user instructions, and additional training specific to CBRN environments and exposures.*

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[2] The maximum use concentration (MUC) for the CBRN APR is the maximum atmospheric concentration of a hazardous substance for which an employee can be expected to be protected and is determined by the lesser of the following:

1. The NIOSH assigned protection factor (APF) multiplied by the contaminant's occupational exposure limit. The NIOSH APF of a CBRN APR equipped with a CBRN canister is equal to 50 when: a) the respirator user adheres to complete program requirements (such as the ones required by OSHA in 29 CFR 1910.134), b) the respirator is assembled in its NIOSH-approved configuration, and c) the user has been individually fit tested to assure a proper fit.
2. The respirator manufacturer's MUC for a hazardous substance (if any).
3. The immediately dangerous to life or health (IDLH) value of the contaminant.

Step 2 - CBRN APR Canister Sticker Label

The CBRN APR canister can be identified by its olive green canister sticker label containing the printed word 'CBRN' and the canister capacity, or 'Cap' level, for example 'Cap 1', in the protections section of the label. The sticker may be a different shape than the example presented below, however all stickers are required to identify the manufacturer, approval number, canister part number, protections, and Cautions and Limitations. The approval number for a CBRN APR will have a TC-14G prefix (TC-14G-XXXX).

If the label does not fit on the canister, the portion of the label below the dashed line may be provided in a form that is removable, as long as the Cautions and Limitations in the box are added. The dashed lines are added here for illustration only, and should not appear on production labels.

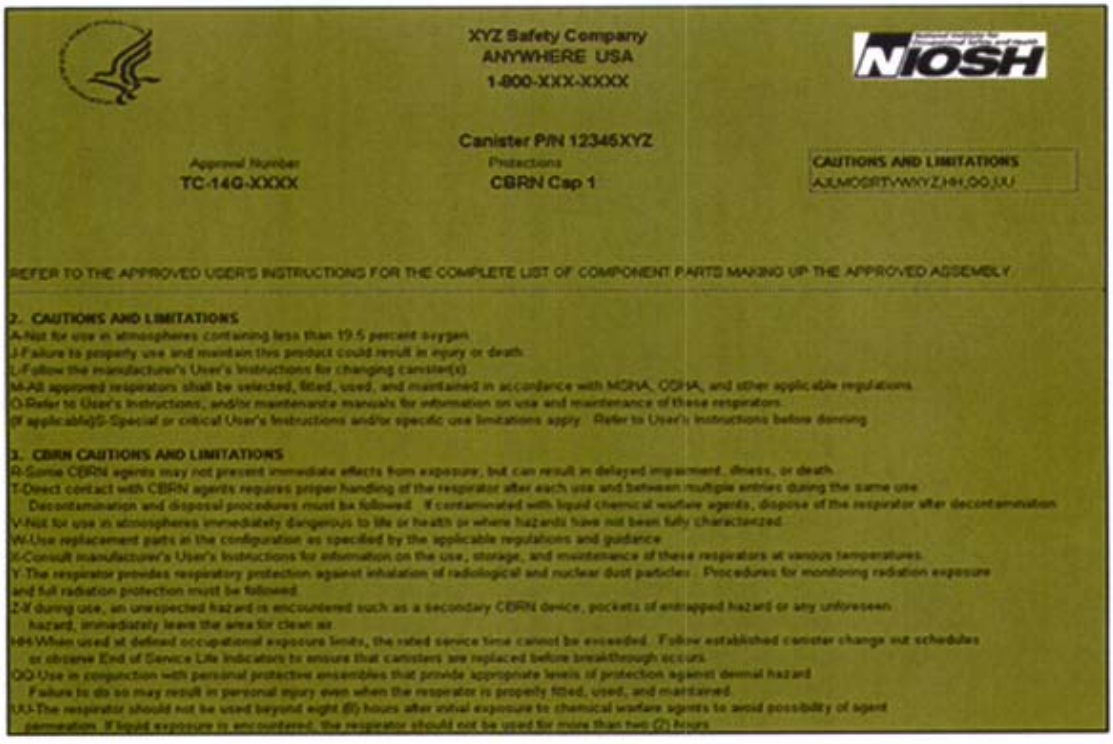

Figure 1. Example of a full canister sticker label with CBRN Cap 1 protection.

Step 3 – 'Matrix-Style' Approval Labels

Information on an approved configuration is provided through the NIOSH, 'matrix-style' approval labels which are part of the user's instructions or included as an insert with the packaging. There are two types of 'matrix-style' approval labels: 1) the canister label, and 2) the respirator label. These labels identify the unique parts and accessories (and their part numbers) which compose the NIOSH-approved respirator configuration. The complete APR assembly and subassemblies must be composed only of those component parts listed in the row with the CBRN approval number. Part numbers that are found only in the rows of the non-CBRN approvals must not be used as part of a CBRN APR assembly.

Canister Label

XYZ Safety Company
ANYWHERE USA
1-800-XXX-XXXX

XYZ AIR-PURIFYING GAS MASK CANISTER

THIS CANISTER IS APPROVED ONLY IN THE FOLLOWING CONFIGURATIONS
RESPIRATOR COMPONENTS

TC-	PROTECTION	CANISTER	ALTERNATE FACEPIECE			Connector & Gasket	SHROUD (CBRN)	NO SECUP	NO SECUP	ACCESSORIES			CAUTIONS AND LIMITATIONS
		CBRN Cap 1	Future, small	Future, medium	Future, large	40 MM Connector	Butyl Coated Nylon Shroud/Hood	Nosecup, small	Nosecup, med / large	Spectacle Kit	Eye Lens Outset	Spectacle Kit	
		12345XYZ	7XYZS	7XYZX	7XYZS	1788XYZ	1788XYZ	7155XYZ	7155XYZ	4636XYZ	777XYZ	4681XYZ	
HIG-XXXX	CBRN Cap 1	X	X	X	X	X	X	X	X	X	X	X	AJLMOSRTVWXYZ HH QQ UU

1. PROTECTION

CBRN Cap 1 - Capacity meets minimum 15 minutes test time

CBRN - Chemical, Biological, Radiological and Nuclear

2. CAUTIONS AND LIMITATIONS

A-Not for use in atmospheres containing less than 19.5 percent oxygen.
J-Failure to properly use and maintain this product could result in injury or death.
L-Follow the manufacturer's User's instructions for changing canisters.
M-All approved respirators shall be selected, fitted, used, and maintained in accordance with MSHA, OSHA, and other applicable regulations.
O-Refer to User's instructions, and/or maintenance manuals for information on use and maintenance of these respirators.
(If applicable)S-Special or critical User's instructions and/or specific use limitations apply. Refer to User's instructions before donning.

3. CBRN CAUTIONS AND LIMITATIONS

R-Some CBRN agents may not present immediate effects from exposure, but can result in delayed impairment, illness, or death.
T-Direct contact with CBRN agents requires proper handling of the respirator after each use and between multiple entries during the same use. Decontamination and disposal procedures must be followed. If contaminated with liquid chemical warfare agents, dispose of the respirator after decontamination.
V-Not for use in atmospheres immediately dangerous to life or health or where hazards have not been fully characterized.
W-Use replacement parts in the configuration as specified by the applicable regulations and guidance.
X-Consult manufacturer's User's instructions for information on the use, storage, and maintenance of these respirators at various temperatures.
Y-The respirator provides respiratory protection against inhalation of radiological and nuclear dust particles. Procedures for monitoring radiation exposure and full radio
Z-If during use, an unexpected hazard is encountered such as a secondary CBRN device, pockets of entrapped hazard or any unforeseen hazard, immediately leave the area for clean air.
HH-When used at defined occupational exposure limits, the rated service time cannot be exceeded. Follow established canister change out schedules or observe End of Service Life Indicators to ensure that canisters are replaced before breakthrough occurs.
QQ-Use in conjunction with personal protective ensembles that provide appropriate levels of protection against dermal hazard. Failure to do so may result in personal injury even when the respirator is properly fitted, used, and maintained.
UU-The respirator should not be used beyond eight (8) hours after initial exposure to chemical warfare agents to avoid possibility of agent permeation. If liquid exposure is encountered, the respirator should not be used for more than two (2) hours.

Figure 2. Example of a 'matrix-style' APR canister approval label with CBRN Cap 1 protection.

Respirator Label

XYZ Safety Company
ANYWHERE USA
1-800-XXX-XXXX

XYZ AIR-PURIFYING GAS MASK RESPIRATOR

THIS RESPIRATOR IS APPROVED ONLY IN THE FOLLOWING CONFIGURATION:
RESPIRATOR COMPONENTS

TC-	PROTECTION[1]	ALTERNATE FACEPIECES			Canister & Gas Mask	SHROUD CBRN	NO SEQUIP	NO SEQUIP	CBRN Cap 1	ACCESSORIES			CAUTIONS AND LIMITATIONS[2]	
		Full face gas mask	Full face gas mask	Full face bag	Gas Mask Canister	Duty Canister Under Chin Canister	Respirator gas mask	Respirator gas mask	CBRN Cap 1	Spare Device Kit	Spare Device Kit	Spare Device Kit		
		1XYZ	1XYZ	1XYZ	1XYZ	1XYZ	1XYZ	1XYZ	1XYZ	1XYZ	1XYZ	1XYZ		
MH-XXXX	CBRN Cap 1	X	X	X	X	X	X	X	X	X	X	X	A,J,M,O,R,T,V,W,X,Y,Z HH GG LM	

1. PROTECTION

CBRN Cap 1 - Capacity meets minimum 15 minutes test time

CBRN - Chemical, Biological, Radiological and Nuclear

2. CAUTIONS AND LIMITATIONS

A-Not for use in atmospheres containing less than 19.5 percent oxygen

J-Failure to properly use and maintain this product could result in injury or death.

L-Follow the manufacturer's User's Instructions for changing canisters.

M-All approved respirators must be selected, fitted, used, and maintained in accordance with MSHA, OSHA, and other applicable regulations.

O-Refer to User's Instructions, and/or maintenance manuals for information on use and maintenance of these respirators.

If accidents occur or without User's Instructions and/or specific use limitations apply. Refer to User's Instructions before donning.

3. CBRN CAUTIONS AND LIMITATIONS

R-Some CBRN agents may not present immediate effects from exposure but can result in delayed incapacitation, illness, or death.

T-Direct contact with CBRN agents requires proper handling of the respirator after each use and between multiple entries during the same use.

Decontamination and disposal procedures must be followed. If contaminated with liquid chemical warfare agents, discard of the respirator after decontamination.

V-Not for use in atmospheres immediately dangerous to life or health or where hazards have not been fully characterized.

W-Use replacement parts in the configuration as specified on the applicable regulations and guidance.

X-Consult manufacturer's User's Instructions for information on the use, storage, and maintenance of these respirators at various temperatures.

Y-The respirator provides respiratory protection against inhalation of radiological and nuclear dust particles. Procedures for monitoring radiation exposure and full radiation protection must be followed.

Z-If during use, an unexpected hazard is encountered such as a secondary CBRN device, accidents of unknown hazard or any unknown hazard, immediately leave the area for clean air.

HH-When used at defined occupational exposure limits, the rated service time cannot be exceeded. Follow established canister change out schedules or observe End of Service Life Indicators to ensure that canisters are replaced before breakthrough occurs.

GG-Use in conjunction with personal protective ensembles that provide appropriate levels of protection against dermal hazards.

Failure to do so may result in personal injury even when the respirator is properly fitted, used, and maintained.

LM-The respirator should not be used beyond eight (8) hours after initial exposure to chemical warfare agents to avoid possibility of agent permeation. If liquid exposure is encountered, the respirator should not be used for more than two (2) hours.

Figure 3. Example of a 'matrix-style' APR respirator approval label with CBRN Cap 1 protection.

Step 4 NIOSH Cautions and Limitations You Need to Know

Background

The notes sections of the NIOSH 'matrix-style' approval labels consist of 3 parts of written information: **1. Protection**, **2. Cautions and Limitations**, and, **3. CBRN Cautions and Limitations.**

Section **1. Protection** contains the acronyms for the approved protections of the APR. The section will state 'CBRN' and the 'Cap' level of the canister, for example, 'CBRN Cap 1'. 'CBRN' means 'chemical, biological, radiological, and nuclear'. 'Cap' means 'canister capacity'. There are six possible levels of canister capacity, ranging from 1 to 6. See Step 8 for a discussion on selecting the canister capacity.

Section **2. Cautions and Limitations** states the 'industrial' NIOSH cautions and limitations for use in a 'non-terrorist' environment, such as an industrial workplace, natural disaster site, or isolated hazardous materials response applications.

Section **3. Cautions and Limitations: CBRN** states the NIOSH cautions and limitations specific to use in CBRN environments, however the **Section 2** statements also apply to CBRN environments.

Step 4 NIOSH Cautions and Limitations You Need to Know

Industrial Use

The following NIOSH cautions and limitations appear in **Section 2** of the CBRN APR 'matrix-style' approval labels and apply to industrial use:

"A" Not for use in atmospheres containing less than 19.5 percent oxygen.

"I" Contains electrical parts which have not been evaluated as an ignition source in flammable or explosive atmospheres by MSHA / NIOSH.

(**Note:** Caution and limitation **"I"** will not be present on units which do not have electrical parts. It will only be present on units which have electrical parts and the parts have not met the MSHA/NIOSH evaluation requirements.)

"J" Failure to properly use and maintain this product could result in injury or death.

"L" Follow the manufacturer's User's Instructions for changing canisters.

"M" All approved respirators shall be selected, fitted, used, and maintained in accordance with MSHA, OSHA, and other applicable regulations.

"O" Refer to User's Instructions and/or maintenance manuals for information on use and maintenance of these respirators.

"S" Special or critical user's instructions and/or specific limitations apply. Refer to User's Instructions before donning.

(**Note:** Caution and limitation "S" will only be present if specified by the manufacturer in the user's instructions. When "S" appears on the NIOSH approval label, the corresponding cautions and limitations that apply under "S" will be explained in a designated section of the manufacturer's user's instructions).

CBRN Use

The following NIOSH cautions and limitations appear in **Section 3** of the CBRN APR 'matrix-style' approval labels and apply to use in CBRN environments (Note: the **Section 2** statements also apply to CBRN environments):

"R" Some CBRN agents may not present immediate effects from exposure, but can result in delayed impairment, illness, or death.

"T" Direct contact with CBRN agents requires proper handling of the respirator after each use and between multiple entries during the same use. Decontamination and disposal procedures must be followed. If contaminated with liquid chemical warfare agents, dispose of the respirator after decontamination.

"V" Not for use in atmospheres immediately dangerous to life and health or where hazards have not been fully characterized.

"W" Use replacement parts in the configuration as specified by the applicable regulations and guidance.

"X" Consult manufacturer's User's Instructions for information on the use, storage, and maintenance of these respirators at various temperatures.

"Y" This respirator provides respiratory protection against inhalation of radiological and nuclear dust particles. Procedures for monitoring radiation exposure and full radiation protection must be followed.

"Z" If during use, an unexpected hazard is encountered, such as a secondary CBRN device, pockets of entrapped hazard or any unforeseen hazard, immediately leave the area for clean air.

"HH" When used at defined occupational exposure limits, the rated service time cannot be exceeded. Follow established canister change schedules or observe End-of-Service-Life Indicators to ensure that canisters are replaced before breakthrough occurs.

"QQ" Use in conjunction with personal protective ensembles that provide appropriate levels of protection against dermal hazard. Failure to do so may result in personal injury even when the respirator is properly fitted, used, and maintained.

"UU" The respirator should not be used beyond eight (8) hours after initial exposure to chemical warfare agents to avoid possibility of agent permeation. If liquid exposure is encountered, the respirator should not be used for more than two (2) hours.

(Note **'UU'** refers to the CBRN Respirator use life (CRUL) when the APR is used in nerve and blister agent environments. See Step 5 for a discussion of CRUL.)

Step 4 NIOSH Cautions and Limitations You Need to Know

Dermal Protective Suits

Caution and Limitation "QQ" pertains to use of the CBRN APR in conjunction with dermal protective ensembles. Some CBRN hazards, depending on their type and concentration, can produce toxic effects by contact with the skin. These effects can be immediate or delayed depending on the type of contaminant. The appropriate level of dermal protection should be used. Proper selection of personal protective equipment (PPE) for responders must be based upon a careful assessment of two factors: 1) the hazards anticipated to be present at the scene and, 2) the probable impact of those hazards, based upon the mission role of the individual.

The emergency responder must be provided with appropriate inhalation and dermal protection from suspect or known CBRN hazards. The amount of protection required is material and hazard specific. Physical and durability properties for PPE must meet minimum values for operations at a CBRN terrorism incident scene. The selection of appropriate PPE is normally the responsibility of the Incident Commander or the Safety Officer.

Integration of CBRN APR is possible with firefighter turn out gear, urban search and rescue gear, law enforcement tactical gear, OSHA/EPA Level C and D hazardous waste protective clothing levels, NFPA certified liquid splash ensembles (NPFA standard 1992), and NFPA certified chemical/biological ensembles (NFPA 1994, Class 3).

For those ensembles which incorporate hooded clothing, ensure that the protective suit hood is donned over the CBRN APR head harness. Necessary measures to bridge the gap between the respirator face blank and the protective suit hood and neck interface should be taken as deemed appropriate by the Incident Commander or the Safety Officer.

Step 5 CBRN Respirator Use Life (CRUL)

When a CBRN APR is used in a chemical warfare agent (CWA) environment (nerve or blister agent) it has a limited use life, called the 'CBRN respirator use life' (CRUL). When exposed to a chemical warfare agent *vapor*, the CRUL is eight hours. When exposed to chemical warfare agent *liquid*, the CRUL is 2-hours. The 8-hour (vapor) and 2-hour (liquid) use life means 8 *continuous* hours or 2 *continuous* hours. Use beyond these time periods is not recommended and could lead to increased risk of exposure, sickness, serious injury, or death.

Important aspects of CRUL:

- The time periods are *continuous*, not a sum of smaller time periods of intermittent use.
- The CRUL value only applies to nerve and blister agents:
    - **Nerve agents** include: GA (Tabun), GB (Sarin), GD (Soman), GF (cyclohexyl Sarin), and V-series agents, such as VX
    - **Blister agents** include: H (sulfur mustard), HD (distilled sulfur mustard), nitrogen mustard (HN-1, HN-2 and HN-3) and Lewisite (L, L-1, L-2 and L-3)
- The start of the CRUL time period is the time of initial CWA exposure and is determined by using qualitative or quantitative detection methods in the field, or by laboratory analysis of APR removed from the site.
- CRUL applies to the entire APR (facepiece, canister, and all subassemblies and accessories). At the end of the CRUL time period, the entire APR must be decontaminated and disposed of properly. The APR cannot be reused following the CRUL use time periods.
- The time the user is wearing the APR during decontamination is included within the CRUL time period. The APR must be disposed following the CRUL time periods.
- The time intervals are continuous and cannot be divided; for example, the 8-hour period **cannot** be broken into four different 2-hour periods over the course of a day.

Step 6: User's Instructions

A User's Instructions (UI) manual is included with every purchase of a new CBRN APR. The UI provides model specific guidance on the use of the APR and should be used as part of the respirator training program. If you do not have a copy of the UI, you can obtain one from the respirator manufacturer.

The UI typically includes guidance on:

- Fit-testing and user seal checks
- Pre-use checks
- Donning and doffing
- Unit assembly
- Inspection checklists
- Storage
- Maintenance
- Cleaning
- Checks for unique parts labeled "CBRN" by the manufacturer
- NIOSH Cautions and Limitations
- Unique warning statements specific to each model

Step 7: Canister Protections

The CBRN canister includes protections against a wide range of gases, vapors, and particulates based on two sets of NIOSH approval testing: 1) canister gas life and particulate testing using 11 NIOSH Test Representative Agents (TRAs), and 2) penetration and permeation testing using the complete APR system against the chemical warfare agents distilled sulfur mustard (HD) and Sarin (GB). See Appendix A for a list of 139 terrorist threat protections. In addition to these 139 protections, the canister protects against other gases, vapors, and particulates based on the NIOSH testing.

Figure 1. CBRN canisters. Courtesy of Survivair.

The canister chemical gas/vapor protections based on NIOSH certification testing are:

- Organic Vapors (OV),
- Acid Gases (AG),
- Base Gases (consisting of Allyl amine (CAS # 107-11-9), Ammonia (CAS # 7664-41-7), 1,1-Dimethyl hydrazine (CAS # 57-14-7), Methyl hydrazine (CAS# 60-34-4)),
- Hydrides (consisting of Arsine (CAS # 7784-42-1), Germane (CAS # 7782-65-2), Phosphine (CAS # 7803-51-2), Stibine (CAS # 7803-52-3), and,
- Nitrogen Oxides (consisting of Nitric acid (CAS # 7697-37-2), Nitrogen dioxide (CAS # 10102-43-9), Nitrogen tetraoxide (CAS # 10544-72-6), and Nitrogen trioxide (CAS # 10544-73-7), and,
- Formaldehyde (CAS # 50-00-0)

CBRN APR canisters use P100 filter media for filtering particulates. P100 media is tested to be at least 99.97% efficient (that is, allows no more that 0.03% filter penetration) against a test aerosol of dioctyl phthalate oil having a mass median aerodynamic diameter (MMAD) of 0.3 micrometers. This is considered to be the 'most penetrating particle size' to filtration media. Protections include solid and liquid particulates including:

- Dusts, mists, and fumes
- Bacteria, viruses, and mold
- Radiological/nuclear particulates (particulate-borne radiation emitting alpha and beta particles or gamma radiation)

Step 8: Select the Canister Capacity (Cap)

CBRN APR canisters are approved at 1 of 6 different levels of canister capacity (also called 'Cap'). The different canister capacity levels relate to relative lengths of service time for the filtration of gases and vapors when use conditions are similar (similar contaminant concentration, ambient temperature, relative humidity, and user breathing rate). The Cap rating does not apply to the service time for the filtration of particulates. Concerning particulates, canisters should be changed under consideration of hygiene, when they become difficult to breathe through due to loading (clogging), and when damaged.

The higher the CBRN Cap level designation, the longer the service time of the canister; conversely, the lower the CBRN Cap level designation, the shorter the service time (see Table 1 below). For example, a CBRN Cap 2 canister will have about twice the service life of a CBRN Cap 1 canister when used under similar conditions as the Cap 1 canister. At the time of this publication, all CBRN APR canisters have only been approved with Cap 1 canisters.

If the service life is determined to be too short to be practical, a canister with a higher Cap rating should be selected and a new service life determined, or a CBRN SCBA should be used instead.

Table 1. CBRN APR Canister Capacity Relative Gas/Vapor Service Life

CBRN Canister Capacity Designation	Relative Gas/Vapor Service Life compared to a Cap 1 Canister*
Cap 1	---------
Cap 2	2X
Cap 3	3X
Cap 4	4X
Cap 5	6X
Cap 6	8X

*Under similar use conditions (similar contaminant concentration, ambient temperature, relative humidity, and user breathing rate).

Step 9: Establish a Canister Change Schedule

CBRN canisters have a limited time that they can remain in service before they must be changed. A *service life* must be determined for canisters used to protect against gases or vapors. *Service life* is sometimes referred to as "breakthrough time." Once the service life has been determined, an appropriate *change schedule*[3] can be implemented. Developing a change schedule for a CBRN canister depends on the type of use, either 'Terrorist Activity / Emergency Use', or 'Industrial Use'.

---------- Terrorist Activity / Emergency Use ----------

Usage at a terrorist response or emergency operations is limited to the duration of the NIOSH approval bench test time at concentrations near IDLH levels (See Table 2 below). This will preserve canister capacity in case an escape is needed due to a secondary event, such as an explosion or unexpected chemical release. Duration of use can be proportionately extended at lower concentrations. For example, a Cap 1 rated canister would have a change schedule of 15 minutes if used at near-IDLH concentrations, 30 minutes if used at 50% of IDLH concentrations, 150 minutes if used at 10% of IDLH concentrations, etc.

Table 2. Service Times for CBRN Canisters used for Terrorist Activity / Emergency Use

CBRN Canister Capacity Designation	Maximum Service Time at near IDLH levels (minutes)
Cap 1	15
Cap 2	30
Cap 3	45
Cap 4	60
Cap 5	90
Cap 6	120

---------- Industrial Use ----------

Usage in a traditional industrial or similar scenario where it is determined that those escape contingency capacities are not applicable allows longer duration of use, since reserve of the panic-demand mode capacity would not be required. Duration of use for each of the gases and vapors included in the CBRN protection, when used in these scenarios, is based on developing a change schedule. Change schedules can be developed through experimental tests, manufacturer's recommendations, or using software programs to calculate a service life. The OSHA Respiratory Protection eTool provides guidance on developing a change schedule:

http://www.osha.gov/SLTC/etools/respiratory/change_schedule.html

Additionally, many CBRN APR manufacturers have service life software incorporating their own CBRN canisters on their websites.

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[3] The OSHA Respiratory Protection Standard [29 CFR1910.134] requires that employers implement change schedules for canisters where end-of-service-life indicators (ESLI) do not exist or are not appropriate for the work environment. Presently, no CBRN APR canisters are approved with ESLIs.

Step 10: Facepiece Indications of Concern

You may have donned the APR facepiece incorrectly if:

A) **Problem:** During the user seal-checks, you feel air leaking into (or leaking out of) the facepiece seal,

Corrections

- Loosen the straps, readjust the facepiece, and re-tighten the straps. Be sure to following the manufacturer's instructions for donning the facepiece.
- Perform the user seal-checks again before entering a contaminated environment.

B) **Problem:** The inside of the facepiece is fogged over,

Corrections

- In a clean environment, remove the facepiece and then redon it following the manufacturer's instructions. Perform the user seal checks.
- If recommended by the manufacturer, apply anti-fog solution.

Step 11: Decontamination

Have a plan for the decontamination (decon) and disposal of contaminated CBRN APR.

The 8-hour (vapor) and 2-hour (liquid) CBRN respirator use life (CRUL) use life concept for exposure to chemical warfare agents (nerve or blister agents) includes the time the APR is worn by the user during the decontamination process. See Step 4 for more on CRUL.

If known or suspected contamination is present on the CBRN APR, quickly conduct gross decontamination using all available systems such as ladder truck decon or other field expedient decon operation using high volume, low pressure clean water, to remove surface CBRN agent contamination. Contain and properly dispose of contaminated run-off wash. Certain CBRN agents will not be neutralized while others will be hydrolyzed or diluted while being physically washed off equipment surfaces using these techniques. Contamination avoidance, mitigation, and decontamination practices should be planned out and trained for in advance.

Confirmed contaminated APR must be disposed of in accordance with local regulatory HAZWOPER operations. If time permits, users should ensure that known or potentially contaminated CBRN APR are triple bagged in plastic, labeled with the type of contamination, the amount/type of decontamination solution used, and the technique used to conduct gross decontamination. The amount of exposure time for contaminated APR and the amount of CBRN contamination are also beneficial information relative to disposal. Local and state disposal procedures for specific CBRN agent contamination should be followed.

A decontamination method specific to the type of CBRN contamination present may contribute to the efficacy of decontamination operations. Seek decontamination guidance from the local incident commander or lead federal agency onsite.

Step 12: Special Provisions

Escape Contingency

To address high contaminant concentrations and elevated user breathing rates that emergency responders may experience during an escape from a secondary CBRN event (such as detonation of an explosive device or an unexpected chemical release), NIOSH incorporates high flow canister gas-life testing as part of the approval requirements. CBRN APR canisters are tested to provide protection for a minimum service life of 5 minutes when tested at specified challenge concentrations using the 10 NIOSH TRA gases and vapors at a flow rate of 100 liters per minute at test conditions of 50 ± 5% relative humidity and 25 ± 5 degrees Celsius.

- If unknown or high levels of a hazard are generated after entry into the work area users should immediately leave the area while continuing to wear the CBRN APR.
- After using the respirator to escape, the canister should be replaced before reusing the respirator.

Canister Interchangeability

The design of the CBRN APR enables interchangeable use of CBRN canisters from different CBRN APR manufacturers. This is possible because all CBRN APR canisters have standardized internal threads, and all CBRN APR masks have standardized connectors and gaskets. The interchangeability provision for canisters would typically be used under emergency conditions when there is a restrictive supply of CBRN canisters for a manufacturer's facepiece. The interchangeability provision only applies to CBRN canisters and not to other subassemblies or accessories of a CBRN APR.

- **Users should not interchange canisters until they are instructed to do so by the incident commander or other designated command authority.**
- A CBRN APR assembled with an interchanged canister from a different manufacturer is not in a NIOSH-approved configuration. Respirators are only in their NIOSH-approved configuration if they are assembled correctly and only with the parts listed in their individual approval matrixes.
- The interchangeability provision is only to be implemented during a crisis when supplies of canisters are low. If possible, canisters with the same canister capacity (Cap) level should be used for interchangeability.
- When canister supplies are reinstated, users should return to using the canister approved with their facepiece.

Hydration Accessory

A hydration accessory (drinking tube) can be part of an approved CBRN APR assembly. The hydration accessory is tested by NIOSH for penetration and permeation resistance against Sarin (GB) and distilled sulfur mustard (HD), however it is tested in an 'unengaged' configuration, that is, not connected to a hydration reservoir.

- Because the hydration accessory is not evaluated by NIOSH while engaged, it should only be used while the user is in a *clean, uncontaminated environment* and *engaged to a clean, uncontaminated reservoir*.

- Use of the hydration accessory in a contaminated environment or with a contaminated reservoir is not in accordance with NIOSH guidance.

Appendix A. CBRN APR Canister Terrorist Threat Protections

A NIOSH-approved CBRN APR canister provides protection against a minimum of 139 identified CBRN agents, which are classified into the following 7 families: **Organic Vapors** (61), **Acid Gases** (32), **Base Gases** (4), **Hydrides** (4), **Nitrogen Oxides** (5), **Particulates** (32) [composed of 3 chemical, 13 biological, and 16 radiological and nuclear particulate threats], and **Formaldehyde** (1).

The test representative agents (TRA) NIOSH uses for certification testing to represent each agent family are listed.

Acid Gas Family (32 agents) *5-TRA chemicals are used for NIOSH certification testing to represent the Acid Gas Family.*	*They are Cyanogen Chloride, Hydrogen Cyanide, Hydrogen Sulfide, Phosgene, and Sulfur Dioxide.*
Boron tribromide	Hydrogen chloride
Boron trichloride	Hydrogen cyanide (AC)
Boron trifluoride	Hydrogen fluoride
Bromine	Hydrogen iodide
Bromine chloride	Hydrogen sulfide
Bromine trifluoride	Phosgene (CG)
Carbonyl fluoride	Phosphorus trichloride
Chlorine	Silicon tetrafluoride
Chlorine pentafluoride	Sulfur dioxide
Chlorine trifluoride	Sulfur trioxide
Chlorosulfonic acid	Sulfuric acid
Cyanogen chloride (CK)	Sulfuryl chloride
Dichlorosilane	Titanium tetrachloride
Ethyl phosphonous dichloride	Tungsten hexafluoride
Fluorine	Bromine pentafluoride
Hydrogen bromide	Hydrogen selenide
Nitrogen Oxide Family (5 agents) *1 TRA chemical (nitrogen dioxide) is used for NIOSH certification testing to represent the Nitrogen Oxide Family.*	
Nitric acid	Nitrogen tetraoxide
Nitric acid, fuming	Nitrogen trioxide
Nitrogen dioxide	
Base Gas Family (4 agents) *1 TRA chemical (Ammonia) is used for NIOSH certification testing to represent the Base Gas Family.*	
Allyl amine	Dimethyl hydrazine, 1,2
Ammonia	Methyl hydrazine
Hydride Family (4 agents) *1 TRA chemical (Phosphine) is used for certification testing to represent the Hydride Family.*	
Arsine	Phosphine
Germane	Stibine

Formaldehyde Family (1 agent) *1 TRA chemical (Formaldehyde) is used for certification testing to represent the Formaldehyde Family.*	
Formaldehyde	
Organic Vapor Family (61 agents) *1 TRA chemical (Cyclohexane) is used for certification testing to represent the Organic Vapor Family.*	NOTE: Chemical warfare agents are in this TRA OV family.
Acetone cyanohydrin	Methanesulfonyl chloride
Acrylonitrile	Methyl orthosilicate
Allyl alcohol	Methyl parathion
Allyl chlorocarbonate	Methyl phosphonic dichloride
Bromoacetone	Mustard, lewisite mixture
Bromobenzylcyanide (CA)	Nitrogen mustard HN-1
Chloroacetone	Nitrogen mustard HN-2
Chloroacetonitrile	Nitrogen mustard HN-3
Chloroacetophenone (CN)	N-propyl chloroformate
Chloroacetyl chloride	O-chlorobenzylidene malononitrile (CS)
Chloropicrin (PS)	O-ethyl-s-(2isopropyaminoethyl)methyl phosphonthiolate
Chloropivaloyl chloride	Parathion
Crotonaldehyde	Perchloromethyl mercaptan
Cyclohexyl methyphosphonate	Phenyl mercapatan
Dibenz-(b,f)-1,4-oxazepine (CR)	Phenylcarbylamine chloride
Diketene	Phenyldichloroarsine
Dimethyl sulfate	Phosgene oximedichloroforoxime
Diphenylchloroarsine	Phosphorus oxychloride
Diphenylcyanoarsine	Sarin (GB)
Diphosgene (DP)	Sec-butyl chloroformate
Distilled mustard (HD)	Soman (GD)
Ethyl chloroformate	Tabun (GA)
Ethyl chlorothioformate	Tert-octyl mercapatan
Ethyl phosphonothioicdichloride	Tetraethyl dithiopyrophosphate
Ethyl phosphorodichloridate	Tetraethyl lead
Ethylene dibromide	Tetramethyl lead
Hexachlorocyclopentadiene	Tetranitromethane
Hexaethyl tetraphosphate	Trimethoxysilane
Iso-butyl chloroformate	Trimethylacetyl chloride
Iso-propyl chloroformate	VX
Lewisite (L, L-1, L-2, L-3)	

Particulate Family Canister Protections (32 agents) *1-TRA chemical (dioctyl phthalate/DOP) is used for certification testing to represent the Particulate Family.*	
Particulate- Chemicals (3)	
Sodium azide	
Adamsite	
Sodium fluoroacetate	
Particulate- Biological (13)	
Anthrax	Venezuelan equine encephalitis
Glanders	Brucellosis
Tularemia	Pneumonic Plague
Smallpox	Query (Q) Fever
T-2 Mycotoxins	Viral hemorrhagic fevers
Ricin	Botulism
Staphylococcus enterotoxin B	
Particulate- Radiological / Nuclear (16)	
Carbon 14	Hydrogen 3*
Cobalt 60	Phosphorous 32
Strontium 90	Nickel 63
Iodine 131	Technetium 99m
Promethium 147	Cesium 137
Radium 226	Thallium 204
Uranium 235 & 238	Thorium 232
Americium 241	Plutonium 239