

# Chapter 2

## SCBA

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# SELF CONTAINED BREATHING APPARATUS

## Description



The MSA (Mine Safety Appliance) – CBRN (Chemical, Biological, Radiological, Nuclear) Air Mask is a pressure-demand, self-contained breathing apparatus (SCBA) for use in atmospheres that are known or present the potential to be immediately dangerous to life and health (IDLH). The CBRN part is not meant to imply that this apparatus protects the user from each of these hazards. The SCBA is only compliant with standards set forth for CBRN masks.

## 7 Major Sub-Assemblies

1. First stage regulator
2. Second stage regulator
3. Air cylinder and valve
4. Audi-larm
5. Carrier and harness
6. Face-piece
7. ICM – TX (Integrated pass alarm/gauge)

## First Stage Regulator



The first stage regulator keeps the pressure to the mask-mounted regulator at approximately 80 psi throughout the entire operating pressure range of the cylinder. This regulator has a redundancy feature to minimize the possibility of a first stage failure. This regulator will vent any excess pressure sent to the regulator from the cylinder.

## Second Stage Regulator



This is a pressure demand regulator, which keeps a positive pressure in the face-piece at all times. Removal of the second stage regulator by depressing the upper and lower release buttons will stop the airflow. To restart the regulator, re-insert the second stage regulator into face-piece and inhale sharply. The button automatically disengages the diaphragm, allowing air to flow to the face-piece. The

regulator is a pilot-valve type device which delivers large flow rates accurately and quickly.

## Air Cylinder and Valve



The cylinder valve includes a valve body, cylinder valve inlet tube, hand wheel, safety (burst) disc and pressure gauge. The gauge is calibrated in 100 psi increments. The hand wheel is used to open and close the cylinder valve.

## Audi-larm



**The Audi-larm rings when there is about 25% of the cylinder's rated service time remaining.** The alarm will also ring when the cylinder valve is first opened. This provides the user the audible alarm indication that the system is charged and alarm is cocked. A high pressure hose delivers high-pressure from the alarm to the first stage regulator.

## Carrier and Harness



The carrier consists of a back plate, cylinder strap and latch.

The harness consists of shoulder pads, chest strap, adjustable pull-straps and a waist strap.

## Face- Piece



Your personal face-piece is a small, medium or large size. The lens is super-hardcoated polycarbonate and the lens has a melt temperature of 500 degrees F° to meet NFPA 1981 standard. Applications have shown these to soften and lose structural integrity when prolonged exposures around 300+ degrees F°. are encountered. An inhalation check valve keeps ambient moisture outside of the mask mounted regulator. The exhalation valve is a pressure demand type designed

for low resistance. The speed-on harness is made of flame and heat resistant materials, with a five point suspension.

## ICM-Tx (Integrated Control Module with wireless Transmitter)



The ICM-Tx is an intrinsically safe, integrated heads-up display and an inline PASS (Personal Alert Safety System) device.

This concludes the 7 sub-assemblies of the MASK.

**NOTE:** 45 minute (4500 psig) at 25% will leave 1175 psig or from 7-11 minutes of air when breathing at a *normal* rate. **Increased breathing rates will yield significantly less remaining time for the user.**

## NIGHT FIGHTER / HUD RECEIVER



The Night-Fighter Heads Up Display (HUD) receiver (red arrow in pic) on the face-piece shows the air cylinder content in one quarter increments, from a full cylinder to an empty cylinder by means of LED light pattern. These lights are seen through the lower right corner of the face-piece lens as the user would wear it.

The batteries in the ICM-Tx and the HUD receiver shall be changed at day light savings time and when switching back to normal standard time at a minimum (even if it is not required).

The ICM-Tx HUD receiver will blink one **RED** flashing light when 25% of the air pressure in the cylinder is left. It will blink one **YELLOW** flashing light when the batteries are low and must be changed.

### HUD Receiver Options

To view the HUD receiver's lights, the user must press the GREEN mode button once on the ICM-Tx, which will display the information from the ICM-Tx temporarily on the HUD receiver. If the user wishes to permanently view the HUD receiver's lights (which is recommended), the user must press and hold the GREEN mode button for more than 2 to 3 seconds.

### HUD Receiver Lights & Meanings

<b>G</b>	<b>G</b>	<b>G</b>	<b>G</b>	=	<b>76% to 100%</b> <b>Full Cylinder, 4 Green LED</b> <b>20 Sec. Steadily ON</b>
	<b>G</b>	<b>G</b>	<b>G</b>	=	<b>75% to 51%</b> <b>¾ Full Cylinder, 3 Green LED</b> <b>20 Sec. Steadily ON</b>
	<b>Y</b>	<b>Y</b>		=	<b>50% to 26%</b> <b>½ Full Cylinder, 2 Yellow LED</b> <b>30 Sec. Flashing ON/OFF</b>
<b>R</b>				=	<b>25% to 0%</b> <b>¼ Full Cylinder, 1 Red LED</b> <b>Flashing Continuously</b>

- One Yellow light flashing is a low battery indicator
- One Orange light flashing is the pre-alarm for the ICM-Tx unit.

**NOTE:** The *user's* face-piece must be within 12" to 15" of their own ICM-Tx in order to read and display the indicator lights at the HUD from *their* cylinder.

## ICM-Tx



In the event that the user remains motionless for approximately **20** seconds, the ICM-Tx will enter into a pre-alarm mode. During the pre alarm mode, a RED light on ICM will flash and an audible signal will begin. Moving or shaking the ICM-Tx at this time will reset the ICM into normal operation and restart the **20** second countdown.

If the user remains motionless, once in pre-alarm, for approximately **30** more seconds, the unit will go into full-alarm mode. During the full-alarm mode, the unit will sound two high pitched tones followed by a buzz. The RED light on the unit will flash rapidly.

The ICM-Tx can be placed into full-alarm mode manually (with or without air pressure in the cylinder) by pressing and holding down the **ALARM** button for longer than **1** second.

The ICM-Tx operates on (4) AA batteries and notifies the user when they are in need of replacement by emitting audible beeps (**once every five seconds**), displaying an empty battery icon on the LCD screen and by flashing a YELLOW light on the HUD.



The **RESET/OFF** button (green arrow in pic.) located on the side of the unit resets the device from the full ALARM mode (2 presses). It also shuts off the unit after the cylinder valve is closed and all air pressure is bled from the unit (2 presses).

The ICM-Tx is equipped with a thermal alarm as well. This is an audible signal (**1 Beep every 3 seconds**) and a flashing thermometer on the LCD display. The unit will go into thermal warning alarm at 500 degrees after 3-4 minutes, and at 200 degrees it will alarm after about 30 minutes.



The top green **MODE** button (yellow arrow in pic) is used for unit system information. Pressing it 1 time will light up the LCD screen and refresh or relight the HUD receiver on the face-piece. While the screen is still lit, pressing the MODE button again will change the LCD screen from remaining cylinder pressure to calculated remaining service life of the cylinder. This service life number can change based on breathing/usage

rates. Holding the MODE button down for more than 2-3 seconds will permanently display all HUD receiver messages.

## ICM-Tx SPECIFICATIONS

Alarm Output:	95dBA @ 10 feet
Batteries:	(4) AA
Battery Life:	25 hours, in full alarm with new batteries

## EMERGENCY TRANS-FILLING

### EEBSS (Emergency Escape Breathing Support System)



The Seattle Fire Department SCBA's are also equipped with a means to trans-fill another member should he/she become low on air while in a IDLH environment. A 3' high- pressure, emergency trans-fill braided hose (picture) capable of transferring air from a "donor" to a "receiver" is supplied in a kevlar pouch located on the left side of the waist strap. An emergency trans-fill should only take place in

an emergency situation and shall not be used in order to extend work time inside an IDLH environment. The "donor" must have at least 2000 psi in his/her air cylinder *before* the connection is made. The "donor" shall use the "receiver's" 3' hose and make the connections. After connections have been made approximately 30-60 seconds are needed to equalize the two cylinders. The time needed is dependent on the difference between the two pressures before the connection was made. After 30-60 seconds the "donor" may disconnect. Leave the receiver connected should he/she need additional air later.

## EMERGENCY TRANS-FILL PROCEDURES

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**NOTE:** The emergency trans-fill procedure is a step-by-step process. These steps need to be followed in order to assure that air is not wasted and that the receiver actually gets the intended air supply from the donor.

### Member Found Down, Reason Unknown:

1. Make sure that the cylinder valve is fully opened.
2. Remove the receiver's 3' emergency trans-fill hose from the Kevlar pouch.
3. Check to make sure that the receiver's face-piece is on the receiver's face.
4. Make certain that the MMR is in and connected to the face-piece and that the second stage regulator is functioning. The emergency bypass should be cracked to ensure air to the receiver's face.
5. Remove the rubber end covers on the receiver's ICM-Tx **or** audi-larm connection and the 3' trans-fill hose.
6. Make the connection to the receiver, then pull on the hose to ensure connection (a click should be heard).
7. Remove the rubber end covers on the donor's ICM-Tx and trans-fill hose.
8. Make the connection to the donor, pull on hose to ensure connection (another click should be heard).

After both connections are properly made, the process may take anywhere from 30-60 seconds to fully equalize both cylinders. The time required to equalize depends on what the difference in air pressure was between the receiver and donor before the connection was made. Extrication/Removal from the IDLH environment should not be stalled while waiting for the trans-fill to complete equalization. After the two cylinders have equalized, the donor should disconnect from their ICM-Tx trans-fill connection, but leave the 3' trans-fill hose connected to the receiver incase they should require more air.

Again, the order of connection is Receiver then Donor....To disconnect the Donor removes the 3' hose from **their** ICM-Tx, leaving the 3' hose connected to the Receiver.

## Trans-fill / Quick-fill Connections



Connection on the ICM-Tx.



Connection on the Audi-larm near the alarm bell.

It is difficult for the donor to connect to their own Audi-larm connection (#2) since it is behind the user near the cylinder gauge and almost completely inaccessible. The ICM-Tx connection (#1) provides an easy access and timely connection point for the donor to connect to (in front of the user at the chest).

## Emergency Bypass Valve



The Emergency Bypass (green arrow in pic) is located on the right side of the second stage regulator as if the user were wearing it. The Emergency Bypass is designed to be used should there be a malfunction of the second stage regulator (inability to breathe due to malfunction).

To activate the emergency bypass, the red knob is turned counter-clockwise or (top turned toward the user). This will provide airflow from the first stage regulator to the inside of the face-piece of pressures up to 80 psi. The Emergency Bypass should only be opened far enough to allow the user to breathe easily based on their breathing demand. The Emergency Bypass valve bypasses the pressure demand system of the second stage regulator; it provides a constant flow of air to the inside of the face-piece whether the user is inhaling or not.

