

HI-Q ENVIRONMENTAL PRODUCTS COMPANY

Air Sampling Equipment, Systems & Accessories

TEST CERTIFICATION

Cartridge P/N:	TCGA-45
Media Type:	30 x 50 Mesh, 5% TEDA Impregnated Carbon
Media Lot #:	I-21071

The enclosed data is provided for HI-Q Environmental Products Company's analytical cartridges, Catalog Number TCGA-45, containing 5% TEDA Impregnated, 30 x 50 mesh, Carbon filter media, Lot # I-21071.

This filter media was tested in TC-Series Cartridge form by Environmental Engineering & Testing, Inc., an independent laboratory, according to the American Society for Testing of Material's retention efficiency test method ASTM-D-3803-98, Sect 12. The tests were performed on TC-45 cartridges, containing material from the same lot as that in the TCGA-45 cartridges, at **5 individual flow rate points** (0.5, 1.0, 2.0, 3.0, & 4.0 SCFM), at both a **18-Hour** Pre-Equilibration & a **168-Hour** (7 day) Pre-Equilibration for a total of **10 tests**, with one duplicate confirmation test point at 2.0 SCFM, through 11 separate carbon cartridges manufactured from a random sampling of HI-Q's latest batch of 30 X 50 mesh TEDA impregnated carbon, Lot # I-21071. A cumulative performance curve is included with this report. Copies of each lot specific, individual test report are available from HI-Q. For comparison purposes and to provide proof of overall better collection efficiency of larger/higher volume cans, one additional test (12th test) was performed at a flow rate of 2.0 SCFM through a randomly chosen TCAL-45 cartridge. The TCAL-45 series cartridge has a ~25% larger carbon capacity than that of the TC-45 cartridges tested. With the fact that the TCGA-45 has more than double the volume of the TC-45 and slightly less than double of that found in the TCAL-45, we have considerable confidence, when making comparisons, that the TCGA-45 series cartridge will perform much better than what is depicted on the TC-45 & TCAL-45 flow vs. collection efficiency chart.

QUALITY ASSURANCE:

HI-Q Environmental Products Company manufacturers all of its cartridges under an **ISO 9001:2000 Certified** quality assurance program (see www.HI-Q.net for a copy of HI-Q's certificate). Following the procedures set forth in their Quality Assurance Program ensures repeatable performance and dimensions of each cartridge manufactured. HI-Q specifically has each individual lot of carbon and silver zeolite, from which the individual cartridges are made, randomly tested and certified by an independent testing laboratory at multiple sample flow rate points through the most common geometry of cartridges utilized in the nuclear industry. The Lot-Specific test results are included with each customer order.

SHELF LIFE:

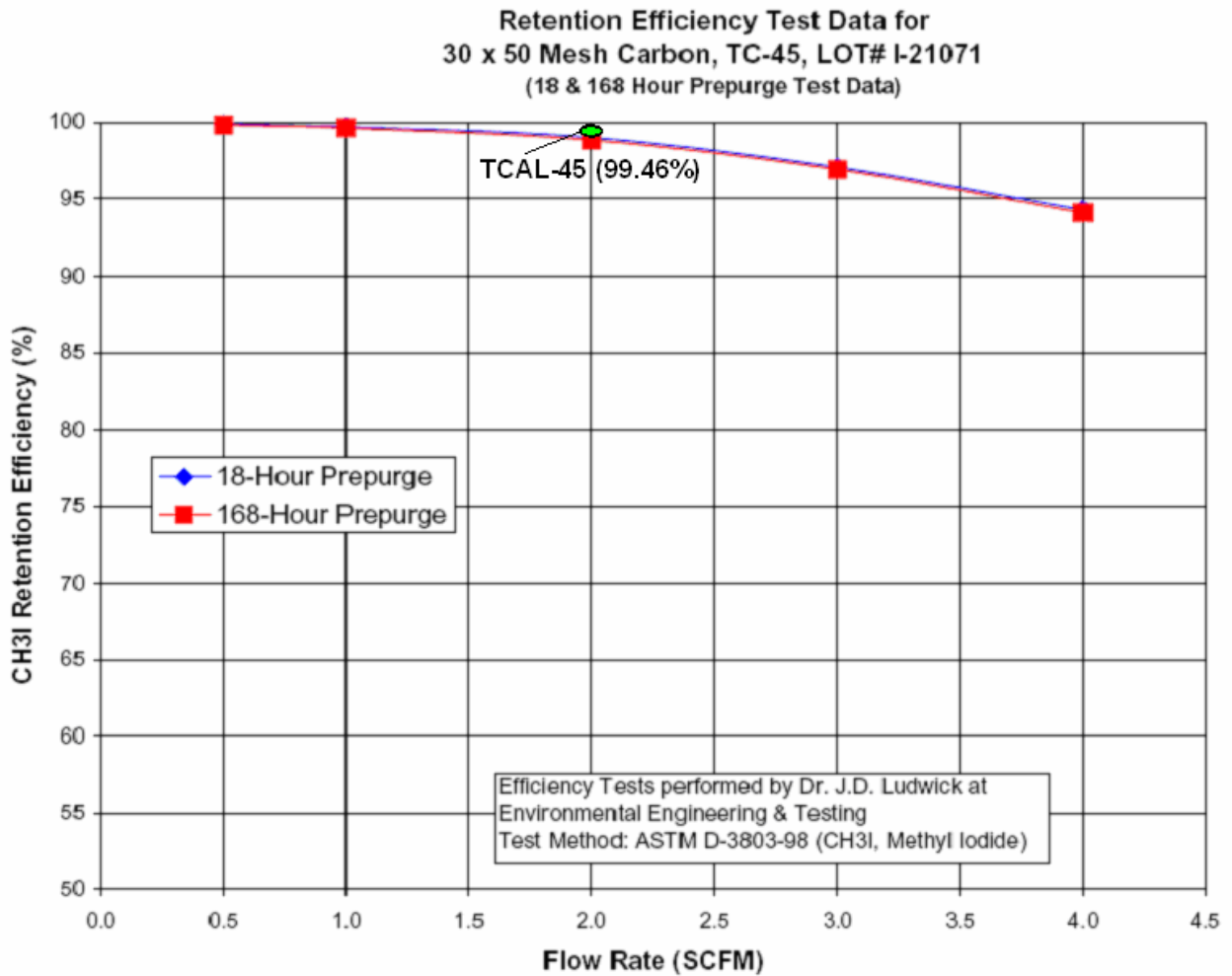
The individually labeled cartridges are heat-sealed in airtight 6 mil polyethylene packages or sleeves. If left unopened, the shelf life of each cartridge is 10 years from the date of manufacture.

Certified by: _____

Date: _____

Raw Test Data

Flow Rate (CFM)	Methyl Iodide Retention Efficiency %		Pressure Drop (Inches Hg)
	18-Hour Prepurge	168-Hour Prepurge	
0.5	99.89	99.84	0.14
1.0	99.73	99.66	0.32
2.0	99.01 (TCAL-45 = 99.46)	98.86	0.77
3.0	97.08	96.94	1.36
4.0	94.29	94.10	2.15



Environmental Engineering & Testing, Inc.

P.O. Box 1012

Richland, WA 99352

(509) 554 2007

CERTIFIED REPORT

TEST RESULTS No: DATE: INVOICE No:

CUSTOMER: PURCHASE ORDER

ADSORBER TYPE:
 DENSITY: g/cc

SAMPLE SOURCE:

SAMPLE HISTORY:

TEMPERATURE: PRESSURE:

RELATIVE HUMIDITY: POLLUTANT TYPE:

FLOW RATE: POLLUTANT CONCENTRATION:

TEST METHOD:

PRE-EQUILIBRATION: POLLUTANT LOAD: ELUTION:

SAMPLE WT (g): DRIED WT: POST TEST WT: MOISTURE %

SECTION No:	CUMULATIVE TEST BED	CUMULATIVE DECONTAMINATION EFFICIENCY	
		IODINE	METHYL IODIDE
C-1	1"	<input type="text" value=""/>	<input type="text" value="99.46 ± 0.08"/>
C-2	2"	<input type="text" value=""/>	<input type="text" value=""/>
C-3	4"	<input type="text" value=""/>	<input type="text" value=""/>
C-x	BACKUP BEDS	<input type="text" value=""/>	<input type="text" value=""/>

REMARKS


TECHNICIAN / REVIEWER


DR. J.D. LUDWICK, PRESIDENT

ENVIRONMENTAL ENGINEERING & TESTING

P. O. BOX 1012

RICHLAND, WASHINGTON 99352

CERTIFICATE OF PERFORMANCE

CARTRIDGE TYPE: **HI-Q TC-45** (TCAL-45)

BATCH NUMBER: LOT# I-21071

These cartridges have been tested by Environmental Engineering & Testing, Inc. The quality control and quality assurance programs for cartridge testing meet the requirements of Appendix B of 10 CFR Part 50 and are available for inspection. Test results are summarized on the attached data sheet. This certifies that the retention efficiencies for methyl iodide at 30 C and 95% RH ASTM D-3803-89, Sect 12 for this batch meet the following minimum requirements.

Flow Rate	Minimum Retention Efficiency
0.5	99%
1.0	99%
2.0	98%
3.0	96%
4.0	94%

Pressure Drop does not exceed: 2.15" Hg @ 4.0 SCFM

CERTIFIED: *J. D. Ludwick*

DATE: APRIL 30, 2006 J. D. Ludwick PhD

ENVIRONMENTAL ENGINEERING & TESTING

4000 BEACH LOOP
BANDON, OR 97411

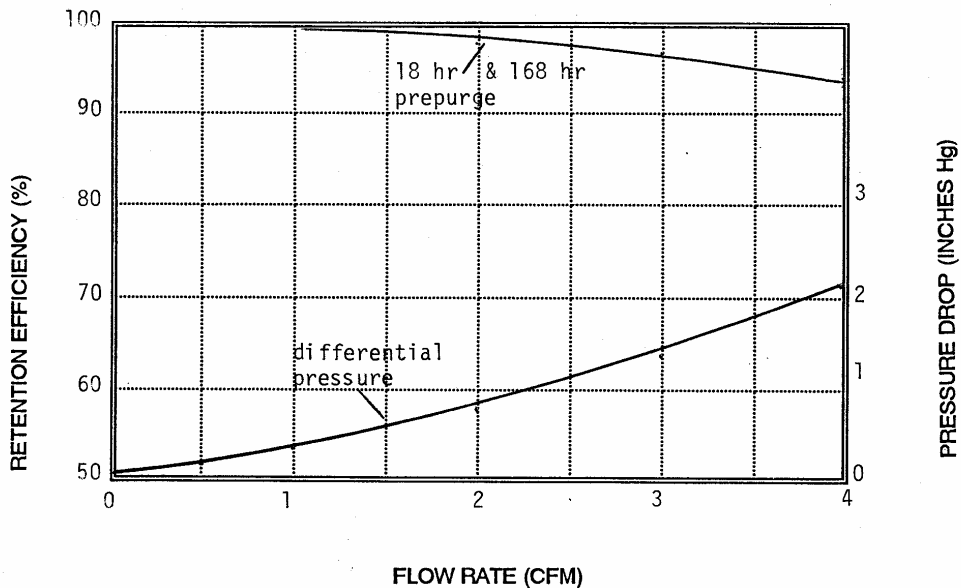
P.O. BOX 1012
RICHLAND, WA 99352

RETENTION EFFICIENCY TEST DATA

CARTRIDGE TYPE: **HI-Q** TC-45 (TCAL-45)

BATCH NUMBER: LOT# I-21071 DATE: APRIL 30, 2006

FLOW RATE (CFM)	METHYL IODIDE RETENTION EFF. (%)		PRESS. DROP (INCHES Hg)
	18-HOUR PREPURGE	168-HOUR PREPURGE	
0.5	99.89	99.84	0.14
1.0	99.73	99.66	0.32
2.0	99.01, 99.28	98.86	0.77
3.0	97.08	96.94	1.36
4.0	94.29	94.10	2.15



EFFICIENCY TESTING OF RADIOIODINE ANALYTICAL CARTRIDGES

INTRODUCTION

The testing of adsorbent media such as activated carbon and silver zeolite for use in analytical testing cartridges is done by using the test procedures outlined by the American Society for Testing and Materials - ASTM. This procedure uses a tagged gaseous compound called methyl iodide as to determine the collection and retention efficiencies of the filter media. This ASTM method designated as D-3803, methods A-E, 1998 utilizes a fixed volume of media, 2" bed depth and the following conditions;

The conditions for analysis for the ASTM-D-3803-1998 are briefly stated as follows:

1) Pressure:	1 Atmosphere
2) Temperature:	30°C
3) Relative Humidity:	95% RAH.
4) Pre-Equilibration (Standard Test)	18 Hours
5) Pre-Equilibration (Extra Test for HI-Q)	168 Hours (7 Days)
6) Mass concentration	CH ₃ I: 1.75mg/M ³
7) Loading period:	60 Minutes
8) Elution Period (post sweep):	60 Minutes
9) Bed Size:	2"
10) Flow Rate:	0.5 to 4.0 SCFM

Filter media can be of various mesh sizes, be impregnated with various amounts of chemical such as the chelating agent TEDA or with various amounts of silver in the silver zeolite media. This variability requires that extensive tests be conducted to define what the performance of a specific media might be under sampling conditions. The standard ASTM D3803 procedures are intended only for comparison of fixed quantities of media under constant laboratory conditions. The results can then be compared to determine such things as pass or fail for established minimum adsorption efficiencies.

ADDITIONAL TESTING

While the ASTM D-3803 method A is a good comparative indicator of collection efficiency, additional tests are conducted by HI-Q that give indications of what one might expect to achieve in actual field test conditions.

Environmental air sampling is never conducted under the same conditions as those used in a laboratory. This is due to the fact that one cannot control most environmental conditions. Media holding cartridges are of variable sizes, volumes and thicknesses than that of the test container used in the ASTM benchmark analysis. In actual use of the analytical cartridges, there is no set pre-humidification for 18 hours, no fixed loading concentration or duration, no control of temperature, and most importantly, collection at a varied flow rate dependent on the scientists requirements.

In an effort to provide its' customers with realistic and usable data and estimates that can predict potential collection efficiencies at sampling conditions found in the field, HI-Q has instigated testing of its' cartridges beyond the ASTM D-3803 method A test point. These tests are conducted on the media under conditions that more closely approximated general sampling procedures. HI-Q has each batch of it's TEDA impregnated carbon and silver impregnated zeolite tested in actual cartridge configuration, at individual flow rates of 0.5, 1.0, 2.0, 3.0 & 4.0 SCFM at both an 18 and 168 Hour Pre-Equilibration, for a total of 10 tests, through 10 individual, randomly chosen, cartridges, by an approved outside consulting laboratory for retention efficiencies of methyl iodide using the ASTM method A, 1998 procedure. Each lot is provided with a collection efficiency certification showing the two individual retention efficiency curves of flow rate (0.5 to 4.0 SCFM) vs. collection efficiency for both 18 hour and 168 hour (7-day) pre-equilibration. Additionally, HI-Q has the testing laboratory randomly duplicate a single test point (11th test) to confirm consistency of performance.

One other major aspect of sampling that HI-Q finds necessary for consideration, is that methyl iodide is used as the test gas because it is volatile at ambient temperatures and is the smallest molecule with the poorest collection efficiency. Results then are close to a worst case scenario. Every other specie of iodine including molecular sublimed iodine has a higher retention efficiency. In fact molecular iodine can and does condense on dust particles or cold surfaces which is termed particulate iodine. Methyl iodide is a rare specie, if found at all, in the nuclear power generation environment.

QUALITY ASSURANCE:

HI-Q Environmental Products Company manufacturers all of its cartridges under an **ISO 9001:2000 Certified** quality assurance program (see www.HI-Q.net for a copy of HI-Q's certificate). Following the procedures set forth in their Quality Assurance Program ensures repeatable performance and dimensions of each cartridge manufactured. HI-Q specifically has each individual lot of carbon and silver zeolite, from which the individual cartridges are made, randomly tested and certified by an independent testing laboratory, at multiple sample flow rate points through the most common geometry of cartridges utilized in the nuclear industry. The Lot-Specific test results are included with each customer order.

HI-Q uses the highest quality coconut shell activated carbon impregnated with 5% TEDA distributed by gas phase dispersion. The silver zeolite media is made by exchange of photographic grade 99.99% silver nitrate on 13X molecular sieve substrate. Moisture levels are maintained at 10% in the AGX media.

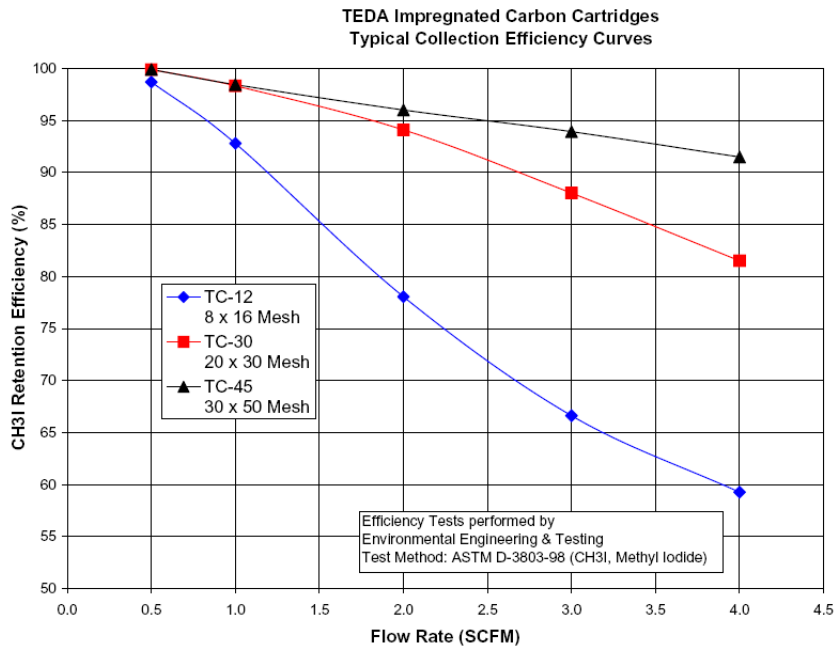
TECHNICAL DATA

5% TEDA IMPREGNATED COCONUT SHELL CARBON MEDIA

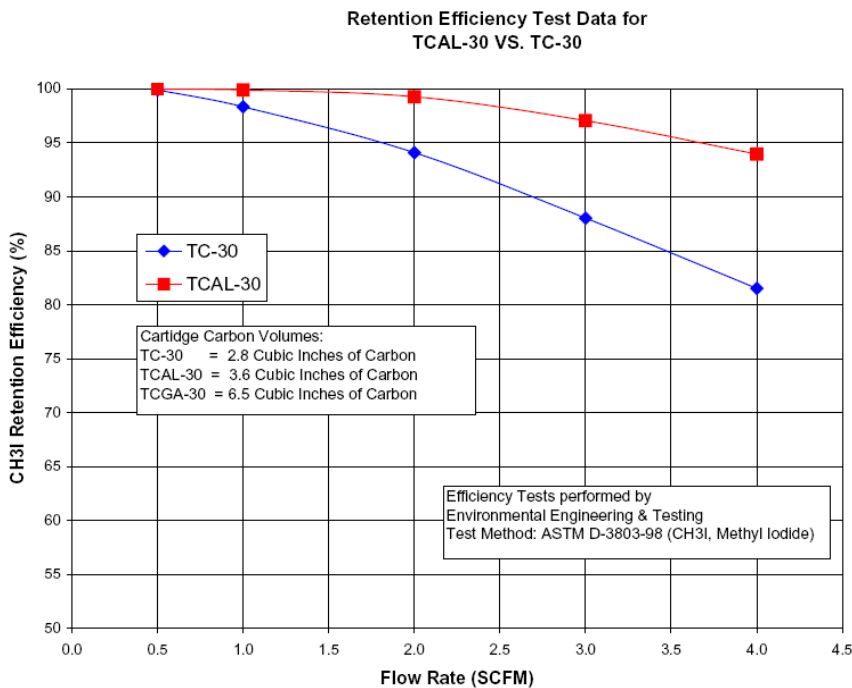
This data represents the typical analysis of the TEDA impregnated carbon media used in the analytical cartridges of all configurations.

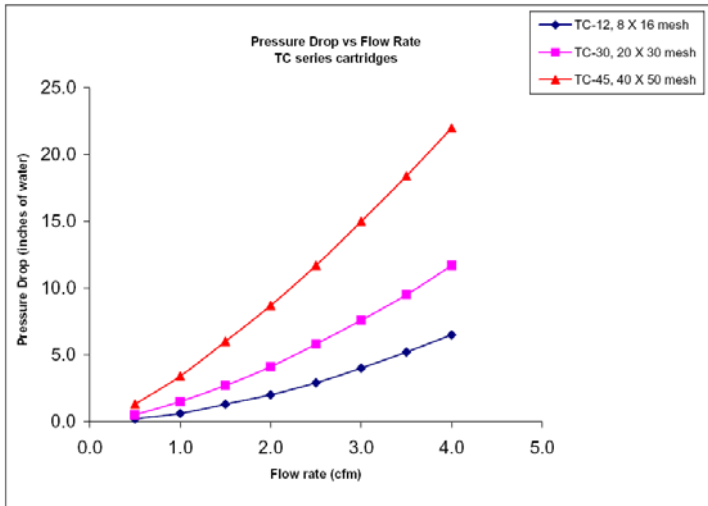
Raw Material	Coconut Shell Carbon
Activation Method	High Temperature Steam
Particle Type	Natural Grain
Carbon Adsorptive Properties	ASTM-D3467 Carbon-Tetra-Chloride Activity = 60% ASTM-D2862, Three mesh sizes are used:8-16 mesh, 20-30mesh and 30-50 mesh.
Impregnant	Triethylene Diamine (Tertiary Amines) 5%
Impregnant Disbursion	Vapor Diffusion
Hardness	ASTM D3802, <u>95% min.</u>
Apparent Density	ASTM D2854, <u>0.38 gm/ml min.</u>
Ash content	ASTM D2866, <u>4% max.</u>
Moisture content	ASTM D3466, <u>5% Average</u>
Ignition Temperature	ASTM D3466,at 100 FPM <u>240°C min.</u>
Surface Area	Typical, 1200/1300 m ² /gram

The following graph contains typical performance curves of three types of carbon cartridges (Plastic, TC-Series) available from HI-Q. Each cartridge is of the same configuration, yet contains a different mesh size of Carbon. The following graph was derived from historical data for comparison purposes. You will notice that the higher number (finer physical mesh carbon) cartridges, have higher per-flow-rate collection efficiency.



Due to the pure volume of carbon contained in the cartridge, the TCAL & TCGA Series (larger volume metal cans) cartridges offer even higher per-flow-rate point collection efficiency results when compare to the TC-Series (smaller volume, plastic) cartridges. Volumes listed below. Comparison based on historical data using mid-range, 20 x 30 mesh, TC-30 & TCAL-30 cartridges.





Pressure Drop vs. Flow Rate Data

TC-Series

2.25" x 1" Plastic Cartridge (yellow)

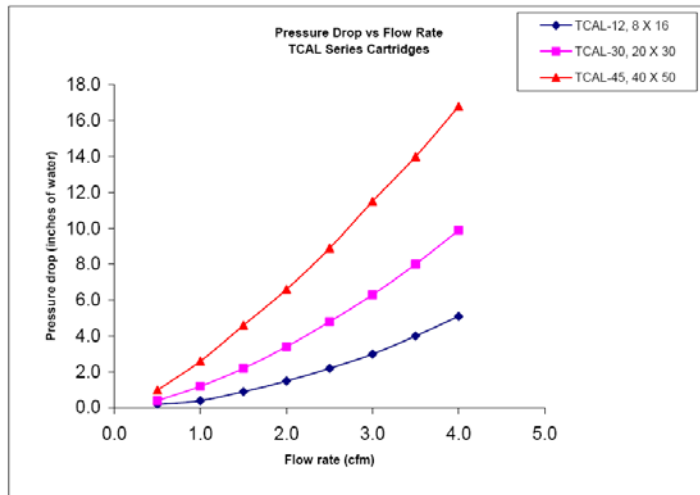
TC-12: 8 x 16 mesh

TC-30: 20 x 30 mesh

TC-45: 40 x 50 mesh

Volume of TC-Series Cartridges:

2.8 cubic inches



Pressure Drop vs. Flow Rate Data

TCAL-Series

2.50" x 1" Metal Can Cartridge

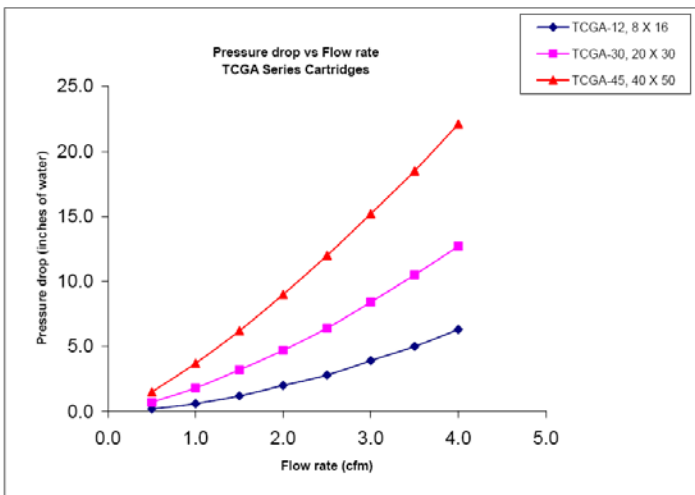
TCAL-12: 8 x 16 mesh

TCAL-30: 20 x 30 mesh

TCAL-45: 40 x 50 mesh

Volume of TCAL-Series Cartridges:

3.6 cubic inches



Pressure Drop vs. Flow Rate Data

TCGA-Series

2.50" x 1.5" Metal Can Cartridge

TCGA-12: 8 x 16 mesh

TCGA-30: 20 x 30 mesh

TCGA-45: 40 x 50 mesh

Volume of TCGA-Series Cartridges:

6.5 cubic inches

MATERIAL SAFETY DATA SHEET

Calgon Carbon Corporation
835 North Cassady Avenue
Columbus, Ohio 43219
Phone: (614) 258-9501 Fax: (614) 258-3464
Emergency Phone Number: (614) 258-4744

Section I - PRODUCT NAME

Activated Carbon Type : 208C5 TEDA

Section II - HAZARDOUS INGREDIENTS

<u>Name</u>	<u>CAS Number</u>	<u>% By Weight</u>
1. Carbon Activated Carbon (Non-Regulated)	7440-44-0	>94
2. Triethyldiamine (ACGIH, OSHA and other TLV are not applicable for activated carbon.)	280-57-9	< 6

Caution: Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state and federal regulations.

SECTION III - PHYSICAL DATA

Boiling Point (°F) : N/A	Specific Gravity (water=1) : 1.9-2.2
Vapor Pressure : N/A	Packing Density (g/cc) : 0.4-0.8
Solubility In Water: N/A	pH : N/A
Appearance & Odor : Black granular or powder odorless	

SECTION IV - FIRE & EXPLOSION HAZARD DATA

Flash Point : N/A	LEL : N/A	Ignition Temperature (°C) : 350
Flammable Limits : N/A	UEL : N/A	

Extinguishing Media : Flood with plenty of water or inert gas, such as N₂ and CO₂
Special Fire Fighting Procedure: None

SECTION V - REACTIVITY

Stability	: Stable
Hazardous Polymerization	: Will not occur
Hazardous Decomposition	: CO may be generated in the event of fire

Condition To Avoid : Contact with strong oxidizers, such as ozone, liquid oxygen, chlorine, permanganate and ketone may cause a bed fire.

Incompatibility : Avoid contact with high concentration of ketone in air or liquid. (Contact Barnebey Sutcliffe for further information.)

SECTION VI - HEALTH HAZARD DATA

Carcinogenicity	: N/A	Skin	: N/A	Ingestion	: N/A
Acute or Chronic	: N/A	NTP	: N/A	IARC Monograph	: N/A
Inhalation	: Dust may be	OSHA	: N/A	inhaled	

Signs & Symptoms of Exposure: Slight irritation of eyes & nose may result from contact with carbon fines
Medical Conditions Generally Aggravated By Exposure : N/A

SECTION VII - EMERGENCY & FIRST AID PROCEDURE

Skin	: N/A	Ingestion	: N/A	Inhalation	: N/A
Eye	: Flush with plenty of water at least for 15 minutes				

Follow-up with physician exam if necessary.

SECTION VIII - SAFE HANDLING & STORAGE

Protective Gloves	: Rubber Gloves	Protective Clothing	: Not required
Eye Protection	: Safety Glasses	Respirator Protection:	A NIOSH approved particulate filter
Ventilation	: Local & Mechanical exhaust recommended		
Storage & Handling	: Avoid generation of dust and fines during handling		

SECTION IX - SPILL OR LEAK PROCEDURE

Notify EPA If Product Spills : Report in accordance with local, state and federal regulations

Cleaning Procedure : Sweep up unused carbon and discard in refuse container or repackage for further use.

SECTION X - OTHER OPERATIONAL INSTRUCTIONS

Calgon Carbon Corporation: MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON