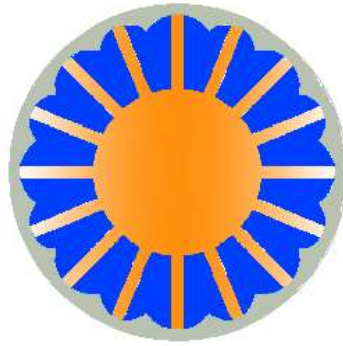


DANIEL OILFIELD TOOLS

“THE PIPE – SEVERED”



OPERATION MANUAL
REVISION JANUARY 2014



DANIEL OILFIELD TOOLS

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This **CHEMICAL CUTTER** Review is published by
DANIEL OILFIELD TOOLS to be used by its
Distributor & Customer as a general reference

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Description

The new design of Chemical Cutter is an Oxidation/Reduction-based mechanical pressure actuated device.

The new Chemical Cutter uses an igniter to electronically initiate the gas generator grain. The grain burns at a controlled rate, increasing the pressure and temperature in the system. Gas pressure acts on the anchoring mechanism to grip the tubing and hold the cutter in place. Gas pressure continues to elevate in the gas chambers, forcing the rupture discs in the cylinder to rupture. The chemical, Bromine Trifluoride, is then ejected through an oil/steel wool mixture in the reaction sub that reacts with the oil and ignites the steel wool.

The combination of the chemical and reactant causes the temperature and pressure in the chamber to elevate. When the system pressure exceeds the hydrostatic well pressure and the strength of the shear washer, the nozzle head piston travels down to expose the nozzle head orifices. Through these orifices, the activated chemical is forced at high pressure to preheat the surface of the tubing and then cut it.

After the chemical has been expelled, pressure in the Chemical Cutter equalizes with the well hydrostatic pressure. The anchoring mechanisms retract under the respective return of spring ball plungers, releasing the tool from the tubing, so that it can be retrieved from the well.

A. Features

- † Based on the oxidation/reduction reaction
- † Uses gas pressure to hold cutter in place
- † Direct Action Slip Design Anchoring Mechanism

B. Benefits

- † Patented Multi-Purpose sub reducing the number of connections
- † Uses less Gas Generator Grain even in harsh conditions
- † Uses less O-Rings, lowering the possibility of pressure leak
- † The time required to assemble the tool is cut by 50%
- † Lower cost due to fewer parts to make up the Chemical Cutter Assembly

Chemical Cutter-Tubing

Specifications

TUBING GUIDE SELECTION

TOOL SPECIFICATIONS (IN)		TUBING SPECIFICATIONS		
TOOL SIZE MPS	MAXIMUM EXTENSION OF ANCHOR SLIPS	OD (INCHES)	ID (INCHES)	WEIGHT LBS/FT
1 3/8	2.10	1.90	1.500-1.650	2.40-3.64
1 1/2	2.20	2 1/16	1.670-1.751	3.25-3.40
		2 3/8	1.703-1.995	4.70-7.70
1 11/16	2.60	2 3/8	1.853-1.995	4.70-5.30
*1 11/16	2.60	2 7/8	2.059-2.441	6.50-10.70
*1 7/8	2.80	2 7/8	2.059-2.441	6.50-10.70
		3 1/2	2.480-2.750	12.95-16.70
*2 1/8	3.20	3 1/2	2.480-3.068	7.70-10.30
3 1/8				

* TOOL HAVE TO BE CENTRALIZED ON TOP OF MPS, AND BOTTOM OF SEVERING HEAD FOR 2 REASONS

- FIRST: ANCHOR SLIPS MAY EXTEND OUT TOO FAR ON ONE SIDE CAUSING MALFUNCTION
- SECOND: SEVERING HEAD MAY LEAN ON ONE SIDE OF THE TUBING WHERE UNEVEN FLOW OF CHEMICAL MAY CAUSE MALFUNCTION

SAFETY PROCEDURES:

The Chemical Cutter Tool should be handled with the same care and precautions as those used in operating any explosive Wireline devices.

No Field Engineer can assemble or disassemble a Chemical Cutter Tool unless he/she has completed the training course offered by Daniel Oilfield Tools on the safe handling of the Chemical Cutter Tool.

Safety equipment supplied by Daniel Oilfield Tools should be used when assembling and disassembling the Chemical Cylinders before and after firing of the tool.

Inspect and mark all Chemical Cylinders for leakage upon receiving and removal from shipping crate. Chemical Cylinders shelf life can be up to 25 years considering yearly leakage inspection on the Cylinders. Store all Chemical Cylinders at least 50 feet from any explosive material. Avoid Mixing empty Cylinders with loaded ones.

Chemical Cylinders should not be dropped, dragged, rolled, or slid. Secure tightly during shipment. Keep the shipping plugs on the end of the cylinders until assembly of tool at the well site.

Do not fire the Chemical Cutter Tool in a well condition temperature below the Bromine Trifluoride freezing point of 48°F. Refer to Temperature vs. Exposure Time Chart for guidance.

Do not ship or transport the Chemical Cutter Tool completely assembled. Keep the igniter, gas generator grain, and Chemical Cylinder disassembled until you assemble at well site.

Keep at least burn ointments and eye wash readily available at well site. Water must be readily available for flushing in case of emergency.

Use the protective Aluminum Cylinders supplied by Daniel Oilfield Tools around the Severing Head and the Multi-Purpose Sub while the tool is connected to the electrical wire line.

In case of a Chemical Spill, use only sand and dirt to contain and neutralize the Chemical.

For more information on how to handle Chemical Cutters and Explosive Devices, refer to the American Petroleum Institutes Recommended Practice 67 (API-RP67)

FIRST AID MEASURES:

Bromine Trifluoride is a highly [toxic](#) and corrosive [fluoride](#) of [bromine](#) with [chemical formula](#) BrF₃. It occurs as a colorless, [yellow](#), or [gray](#) fuming [liquid](#) with an irritating [odor](#). It is soluble in [sulfuric acid](#) and may [explode](#) on contact with [water](#). It has a boiling point of 125.8°C. BrF₃ is extremely corrosive to human tissues and all personnel must wear acid resistant gloves, respirator, and protective clothing supplied by Daniel Oilfield Tools.

A. INHALATIONS

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, Oxygen should be administered by qualified personnel. Get immediate medical attention.

B. SKIN CONTACT

Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly apply Glycerol Paste or a mixture of Bicarbonate of soda and water on burned area. In case of severe burn, do not remove or break blisters while treatment.

C. EYE CONTACT:

Immediately flush eyes with plenty of water for at least 15 minutes. Keep eyelids open while flushing with water. Then get immediate medical attention.

D. INGESTION:

If swallowed, drink plenty of water, do NOT induce vomiting. Get immediate medical attention.

OPERATIONS OF CHEMICAL CUTTER:

DEPTH OF WELL	HYDROSTATIC PRESSURE OF A COLUMN OF SALT WATER OR ROTARY MUD HAVING A DENSITY IN POUNDS PER GALLON OF:												
	FRESH HO	9	SALT HO	10	11	12	13	14 LBS/IN	15	16	17	18	19
1000	433	468	500	520	572	624	676	728	780	832	884	936	988
2000	866	936	1000	1040	1144	1248	1352	1456	1560	1664	1768	1872	1976
3000	1299	1404	1500	1560	1716	1872	2028	2184	2340	2496	2652	2808	2964
4000	1732	1872	2000	2080	2288	2496	2704	2912	3120	3328	3536	3744	3952
5000	2165	2340	2500	2600	2860	3120	3380	3640	3900	4160	4420	4680	4940
6000	2598	2808	3000	3120	3432	3744	4056	4368	4680	4992	5304	5616	5928
7000	3031	3276	3500	3640	4004	4368	4732	5096	5460	5824	6188	6552	6916
8000	3464	3744	4000	4160	4576	4992	5408	5824	6240	6656	7072	7488	7904
9000	3897	4212	4500	4680	5148	5616	6084	6552	7020	7488	7956	8424	8892
10000	4330	4680	5000	5200	5720	6240	6760	7280	7800	8320	8840	9360	9880
11000	4763	5148	5500	5720	6292	6864	7436	8008	8580	9152	9724	10296	10868
12000	5196	5616	6000	6240	6864	7488	8112	8736	9360	9984	10608	11232	11856
13000	5629	6084	6500	6760	7436	8112	8788	9464	10140	10816	11492	12168	12844
14000	6062	6552	7000	7280	8008	8736	9464	10192	10920	11648	12376	13104	13832
15000	6495	7020	7500	7800	8580	9360	10140	10920	11700	12480	13260	14040	14820
16000	6928	7488	8000	8320	9152	9984	10816	11648	12480	13312	14144	14976	15808
17000	7361	7956	8500	8840	9724	10608	11492	12376	13260	14144	15028	15912	16796
18000	7794	8424	9000	9360	10296	11232	12168	13104	14040	14976	15912	16848	17784
19000	8227	8892	9500	9880	10868	11856	12844	13832	14820	15808	16796	17784	18772
20000	8660	9360	10000	10400	11440	12480	13520	14560	15600	16640	17680	18720	19760

HYDROSTATIC PRESSURE 0062 (DEPTH) (MUD WEIGHT)

TOOL SIZE	TUBING		CYLINDER	0-5 KPSI	CHOKE	5-10 KPSI	CHOKE
	INCH	OD					
6875	1	0.688-1.037	11/16 X 72	7.0 X 1/4	N/A	8.0 X 1/4	N/A
7500	1	0.688-1.037	3/4 X 72	7.0 X 1/4	N/A	8.0 X 1/4	N/A
8125	1 1/4	0.840-1.328	3/4 X 72	7.0 X 1/4	N/A	8.0 X 1/4	N/A
9375	1 1/2	1.256-2.239	1 X 72	8.0 X 1/4	N/A	9.0 X 1/4	N/A
1387	1.9	2.40 - 3.64	1 3/8 X 72	7.0 X 9/16	5/32	7.5 X 9/16	5/32
1500	2 1/16	3.25 - 7.70	1 3/8 X 72	7.0 X 9/16	5/32	7.5 X 9/16	5/32
1687	2 3/8	4.70 - 5.30	1 11/16 X 48	8.0 X 9/16	5/32	8.5 X 9/16	5/32
* 1687 E.R.	2 7/8	6.50-10.70	1 11/16 X 60	9.0 X 9/16	5/32	9.5 X 9/16	5/32
1750	2 7/8	6.50-10.70	1 11/16 X 72	9.5 X 9/16	5/32	10.0 X 9/16	5/32
1875	2 7/8	6.50-10.70	1 11/16 X 72	9.5 X 9/16	5/32	10.0 X 9/16	5/32
2000	2 7/8	6.50 - 9.50	1 11/16 X 72	9.5 X 9/16	5/32	10.0 X 9/16	5/32
2000 E.R.	3 1/2	12.95-16.70	2-2 X 48				
2125	2 7/8	6.50 - 7.90	1 11/16 X 60	9.0 X 9/16	5/32	9.5 X 9/16	5/32
2125	2 7/8	6.50 - 7.90	1 11/16 X 72	9.0 X 9/16	5/32	10.0 X 9/16	5/32
2125 E.R.	3 1/2	9.30-16.70	2-2 X 48				
2250	3 1/2	9.30-15.50	1-2 X 72				
2387	3 1/2	7.70-15.50	1-2 X 72				
2625	3 1/2	7.70-10.30	1 11/16 X 72				
2875	4	11.00-15.70	2-2 X 48				
3125	4	9.50-14.00	1-2 X 72				
3250	4 1/2	12.60-20.00	2-2 X 48				
3375	4 1/2	11.60-17.70	2-2 X 48				
3500	4 1/2	9.50-15.50	2-2 X 48				
3625	4 1/2	9.50-13.50	1-2 X 72				
3875	5	15.00-21.00	2-2 X 48				
4000	5	11.50-19.50	1-2 X 72				
4187	5 1/2	20.00-26.00	2-2 X 48				
4437	5 1/2	15.50-23.00	2-2 X 48				
4562	5 1/2	13.00-17.00	1-2 X 72				
5500	7	28.00-35.00	2-2 X 72				
5750	7	20.00-26.00	2-2 X 60				
6375	7 5/8	20.00-33.70	2-2 X 72				

SELECTION GUIDE FOR COILED TUBING CUTTER

TOOL SPECIFICATIONS			COILED TUBING SPECIFICATIONS		
TOOL SIZE		MAX. EXTENSION OF SLIPS	OD	ID	WEIGHT
MPS	CUT HD.		(INCHES)	(INCHES)	LBS/FT
7500	7500	1.15"	1	0.782-0.810	0.918-1.037
7500	7500	1.15"	1	0.826-0.866	0.688-0.848
7500	8125	1.15"	1 1/4	0.938-1.076	1.081-1.823
7500	8750	1.15"	1 1/4	1.032-1.076	1.081-1.328
7500	9375	1.15"	1 1/4	1.100-1.116	0.840-0.941
9375	1000	1.43"	1 1/2	1.188-1.282	1.619-2.239
9375	1062	1.43"	1 1/2	1.188-1.282	1.619-2.239
9375	1125	1.43"	1 1/2	1.282-1.334	1.256-1.619
1125	1187	1.63"	1 3/4	1.374-1.500	2.169-3.136
1125	1250	1.63"	1 3/4	1.400-1.532	1.910-2.944
1387	1387		2	1.594-1.699	3.072-3.896
1387	1500		2	1.732-1.782	2.201-2.671
1687	1687		2 3/8	1.969-2.025	4.112-4.709
1687	1875		2 3/8	2.063-2.157	2.638-4.709
1687	2125	2.81"	2 7/8	2.469-2.563	4.530-5.793
1875	2625	2.81"	2 7/8	2.469-2.563	4.530-5.793
2000	2625	3.20"	3 1/2	3.094-3.150	6.215-7.148

SELECTION GUIDE FOR CS HYDRIL TUBING CUTTER

TOOL SPECIFICATIONS			COILED TUBING SPECIFICATIONS		
TOOL SIZE		MAX. EXTENSION OF SLIPS	OD	ID	WEIGHT
MPS	CUT HD.		(INCHES)	(INCHES)	LBS/FT
7500	7500	1.15"	1.050	0.824	1.200
7500	7500	1.15"	1.315	0.957	2.250
7500	8125	1.15"	1.315	1.049	1.800
9375	1125	1.43"	1.660	1.278	3.020
9375	1187	1.43"	1.660	1.380-1.410	2.100-2.400

OPERATIONS PROCEDURES:

1. Assemble all Chemical Cutter parts by hand. (see page 13)
2. It is very important that both the Multi-purpose sub and the Cutting Head are centralized on every job.
3. A drift gauge must always be run prior to running the Chemical Cutter to insure that no obstructions or restrictions in the well bore that would prevent the tool to reaching the desired Cutting depth.
4. Run the chemical Cutter in an unrestricted and unobstructed tubing, casing, or drill pipe at a maximum speed of 300 FT/Min.
5. **SPUDDING** should never be attempted while running the Chemical Cutter.
6. Acquire the Following:
 - a. Size and weight of string to be cut.
 - b. Smallest restrictions
 - c. Cutting Depth
 - d. BHP
 - e. BHT
 - f. Surface Pressure
 - g. Type of fluid. If no fluid in the hole, pump fluid while the cut is made along with using a swab cup below the Bull Plug.
 - h. Plastic Coated? Scaly pipe? If yes, run a clean out shot covering the length of the Chemical Cutter Tool, and increase your Chemical Load by at least 12".
7. When cutting above a plug, allow 15-20 FT of fluid cushion below the Bull Plug.
8. Anchoring or Cutting a collar should not be attempted with a Chemical Cutter.
9. In case of U-tube effect, equalize pressure by punching holes or by pressurizing the tubing from surface.
10. Run the Chemical Cutter only one run in a well containing H₂S.
11. It is recommended that an over pull be applied when Chemical Cutters are being run.
12. In the presence of Zinc Bromide, Calcium Bromide, and Sodium Bromide, additional Chemical (BrF₃) should be used.
13. Apply Never-Seez Lubricant on all threaded connections ABOVE CHEMICAL CYLINDER and do not use silicone on threads.
14. After making the cut, wait 3-5 minutes for pressure to equalize, move the Chemical Cutter down to help release the slips and then retrieve it from the hole.
15. The Chemical Cutter should be made in two sections:
 - a. Firing Sub, Igniter, and Multi-Purpose Sub.
 - b. Chemical Cylinder, Severing Head, and Bull Plug.
16. After a cut is made, unscrew the Firing Sub Adapter until both O-Rings are exposed so any trapped pressure is released.

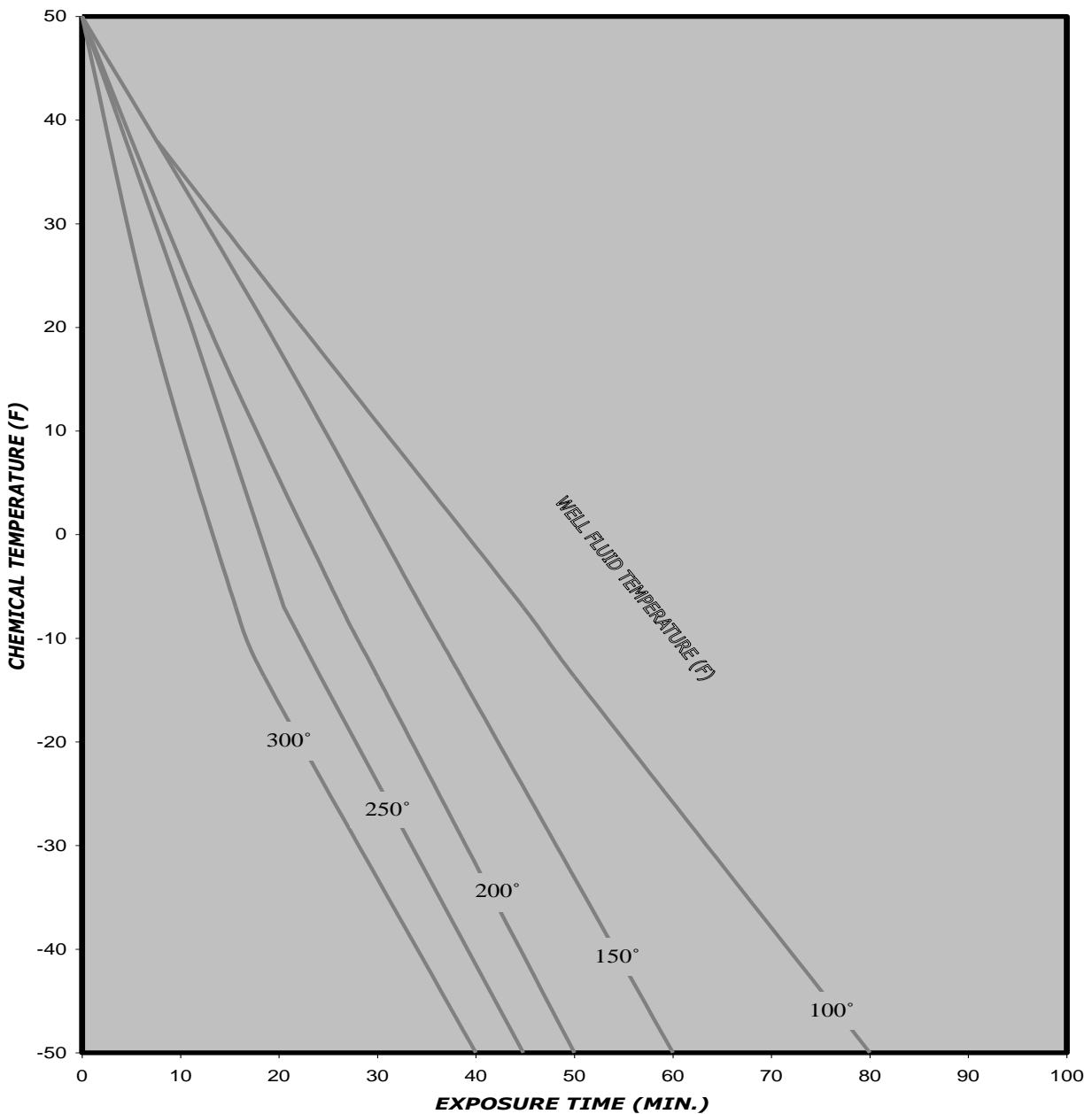
WARNING: DO NOT INJECT SILICONE 111 INTO SEVERING HEAD ORIFICES FOR IT IS NOT RECOMMENDED FOR USE WITH HIGHLY OXIDATIVE CHEMICALS.

PROCEDURES IN EXTREME WEATHER CONDITIONS:

1. The freezing point of Bromine Trifluoride (BrF_3) is 48 °F. It is very critical to operate the Chemical Cutter above the freezing point.
2. Refer to the chart below to acquire the minimum exposure time to well Temperature before initiating the Chemical Cutter.

CASE STUDY: Surface Temperature: -10 ° F
Well fluid Temperature: 300 ° F
Minimum Exposure Time: 15 Minutes

CHEMICAL TEMPERATURE Vs. EXPOSURE TIME



DOT CHEMICAL CUTTER RATINGS

STANDARD CHEMICAL CUTTER:

After many runs and analysis of many field reports, DOT discovered that well hydrostatic pressure and Temperature affect the performance of Chemical Cutters.

When a field job requires a cut at conditions higher than recommended standard chemical cutter ratings, please call DOT for HTHP chemical cutter tool.

Following the table below will help ensure the success of your chemical cutter operation.

RECOMMENDED OPERATIONAL RATINGS

TOOL SIZES	PRESSURE RATING	TEMPERATURE RATING
11/16" TO 15/16 OD TOOLS	5000 PSI	275 °F *
1" TO 1 1/4" OD TOOLS	6000 PSI	300 °F *
1 3/8" TO 6 3/8" OD TOOLS	7500 PSI	300 °F *

RECOMMENDED HTHP OPERATIONAL RATINGS

TOOL SIZES	PRESSURE RATING	TEMPERATURE RATING
1 3/8" TO 6 3/8" OD TOOLS	13000 PSI	450 °F *

* Temperature ratings are given for two hours exposure to downhole conditions.

HARDWARE DESCRIPTION:

The **CHEMICAL CUTTER** manufactured by *Daniel Oilfield Tools* is made up of the following principal components:

1. CROSS OVER Assembly
 2. Multi-Purpose Sub which replaces the following parts that comprises PRS Chemical Cutter:
 - a) Firing Sub Adapter
 - b) Gas Generator Sub
 - c) Pressure Relief Sub
 - d) Anchor Body
 - e) Lower Anchor Body
 3. Chemical Cylinder
 4. Severing Head
 5. Bull Plug or Bull Plug Centralizer
- A) The use of a Lower Centralizer is required when cutting in an undersized pipe but does not add to your overall number of parts that make up your Chemical Cutter.**

TOOL PREPARATION: WITH FIRING SUB ADAPTER

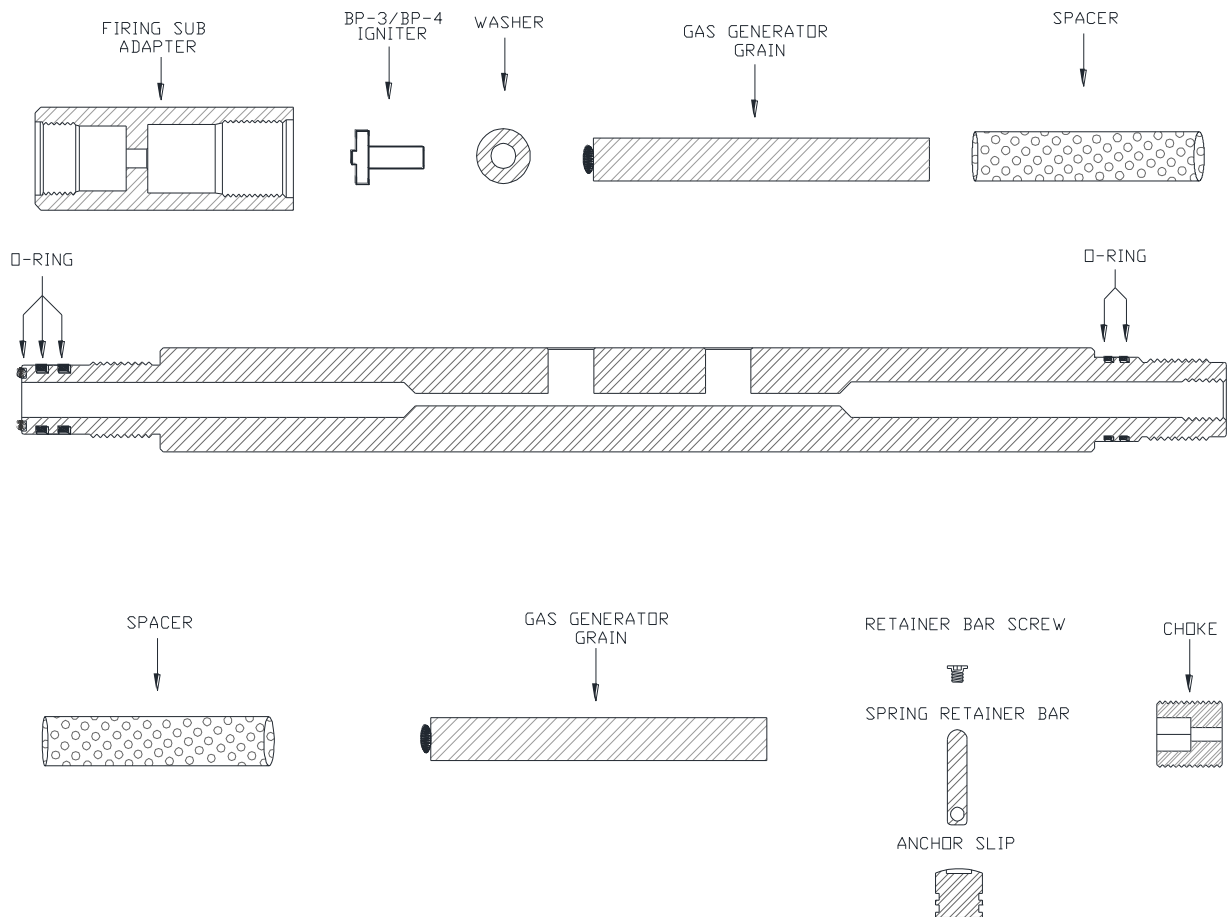
New Parts

Remove oil residue with a degreaser
Inspect all Anchor Slip cavities with the Go/No-Go gauge supplied by Daniel Oilfield Tools.

Used Parts

Clean and Brush all sealing surfaces, threads, and continuous open bores with wire brushes supplied by Daniel Oilfield Tools.

TOOL ASSEMBLY:



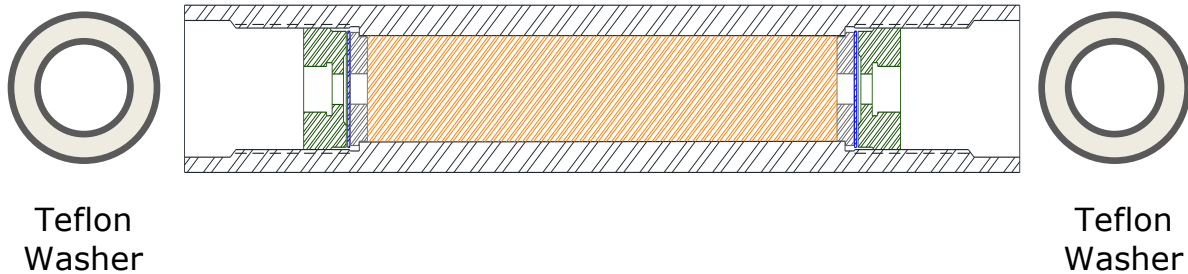
Multi-Purpose Sub Assembly:

1. Place two O-Rings on each end of the Multi-Purpose Sub top and bottom end.
2. Place O-Rings on the Anchor Slips Assemblies. Insert Anchor Slips in one of the six bores. Place the Retainer Leaf Spring on top of the Anchor Slip and assemble the screw to keep Anchor Slip in place and aligned with teeth upward.
3. Insert the Bottom section of the Gas Generator Propellant into the bottom Combustion Chamber of the Multi-Purpose Sub and screw on the Choke in place
4. Insert the Top section of the Gas Generator Propellant into the top Combustion Chamber of the Multi-Purpose Sub. Since we use two sections of propellant, we recommend that you split the propellant evenly between top Combustion Chamber and Bottom Combustion Chamber.
(See Propellant Loading Chart on Page 7)
5. Place one O-Ring on the Top End where the Igniter is to be inserted
6. Insert the BP-3/BP-4 Igniter and screw the Firing Sub Adapter into place
If using the Diamondback Igniter, Insert the O-Ring on bottom of igniter, then the washer provided on the bottom of the Igniter so the igniter will electrically ground.
If you are using the Optional Multi-Purpose Sub without the Firing Sub Adapter, insert the Igniter, and then screw on the Set screw with little torque.
8. Check for continuity with your Safety Ohmmeter

CAUTION: ALL PARTS OF THE CHEMICAL CUTTER ASSEMBLY SHOULD BE ASSEMBLED BY HAND

MAKE SURE THAT ALL SLIPS ARE ORIENTED PROPERLY WITH TEETH ALWAYS FACING UP

CHEMICAL CYLINDER ASSEMBLY:



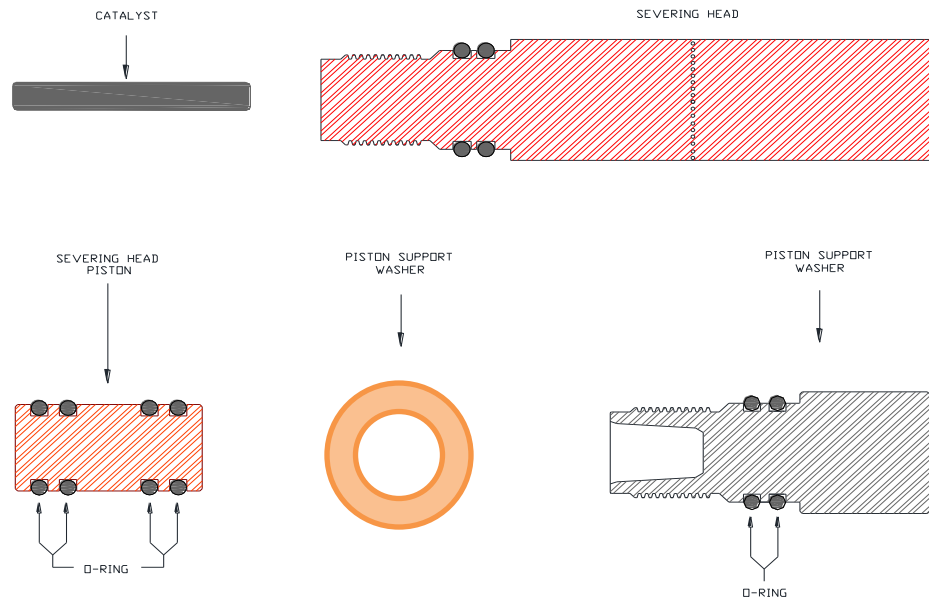
Safety Check Before Assembly

1. Wear the Safety Equipment when assembling the Chemical Cylinder
2. Make sure the Temperature of the Cylinder is not below the Freezing Point of the Bromine Trifluoride (48°F). Warm the Chemical Cylinder if needed.
3. The Cylinder should always be elevated and placed on a Bench Vise at a 60° Angle
4. Hold one Litmus Paper against the vent hole on the Shipping Plug and unscrew the Seal Screw slowly with an Allen Wrench while watching the Litmus Paper for Color Change to Red. If so, Label Cylinder "CHEMICAL LEAKING" and retighten the Seal Screw

CAUTION: DO NOT EVER ATTEMPT TO USE A "CHEMICAL LEAKING" CYLINDER

5. Repeat the previous step on the Bottom end of the Chemical Cylinder if the Top End is not leaking
6. After checking for leaks, screw on the Severing Head Assembly
7. After the separate Assemblies are carried out to the Wellhead, screw on the Multi-Purpose Sub on Top of the other end of the Chemical Cylinder.
8. Screw Cable Head onto the Firing Sub Adapter, Measure for Zero Reference, and lower the Chemical Cutter into the Tubing

SEVERING HEAD – BULL PLUG ASSEMBLY:



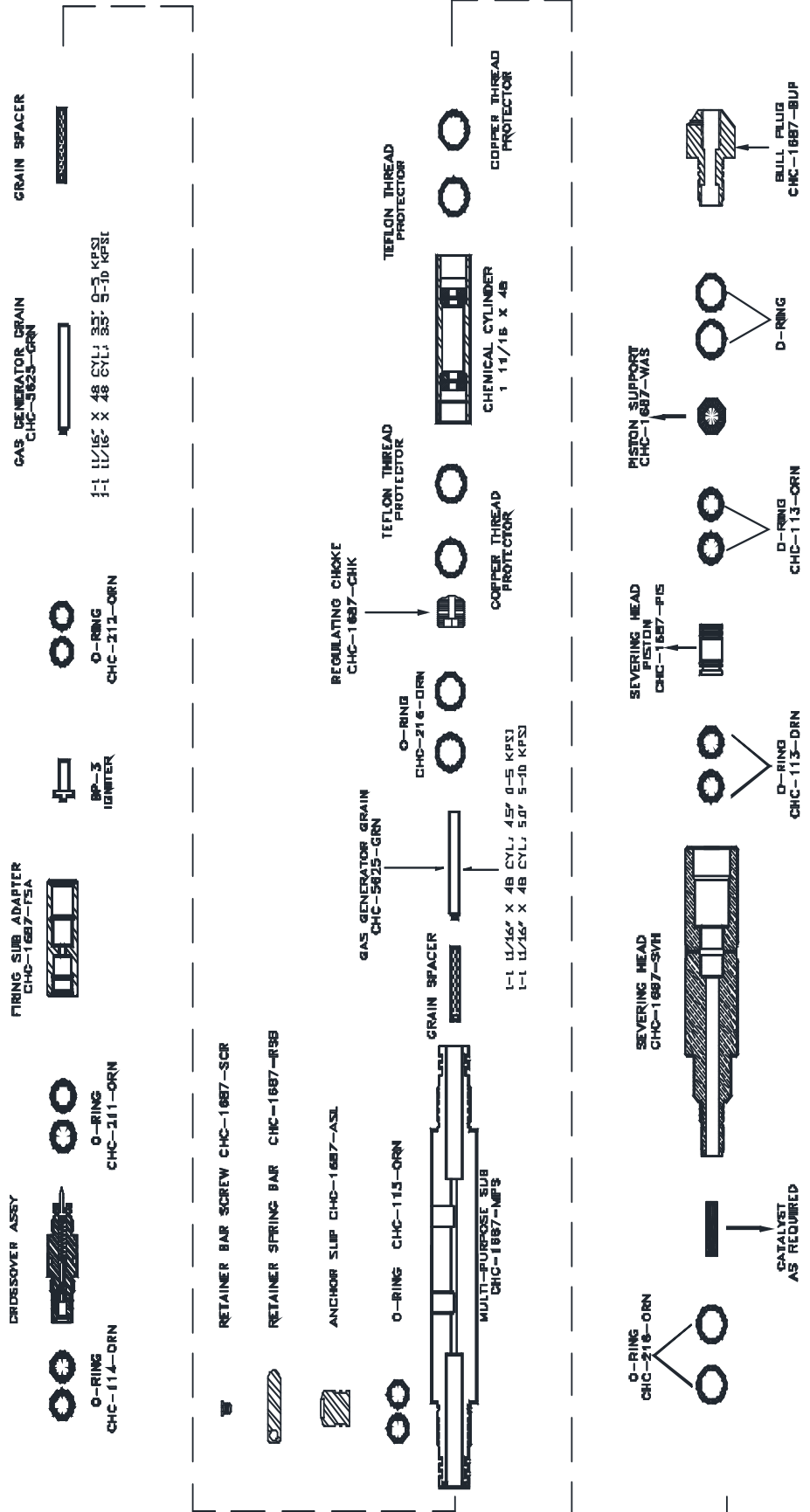
A. Standard Severing Head-Bull Plug Assembly:

1. Place two O-Rings on the top end of the Severing Head.
2. Place four O-Rings on the Piston.
3. Place Grease on Piston O-Rings and insert into the Severing Head until it's flush with the bore shoulder.
NOTE: No other Grease than which is provided from DOT should be used. DO NOT USE THE 111 VALVE LUBRICANT & SEALANT PROVIDED BY PRS
4. Cover the Orifices outer area with Polyimide Tape making 2 to 3 wraps.
5. Remove the Catalyst from its container and form a fluffed cylinder. Insert it into the top end of the Severing Head until its recessed 1/8" from the top end.
6. Insert the Piston Support Washer from the bottom end until it's flushed with bore shoulder.
7. Place O-Rings on the top end of the Bull Plug.
8. **Follow this Step only if you are using a Centralizer Bull Plug:**
 - a) Place the O-Ring on each of the Teflon Slips and insert into each of the three bores in the Centralizer Bull Plug.
 - b) Fill the top end of the Bull Plug with the amount of Hydraulic Oil provided in your Expendable O-ring Kit. **DO NOT ADD MORE HYDRAULIC OIL TO WHAT WAS IN THE BOTTLE.** If you do not have Hydraulic Oil, fill it with water until the level of fluid is about a 1/4" from the bottom of the piston bore seat.
9. Keep the Centralizer Bull Plug straight while screwing it into the Severing Head bottom end.



DANIEL OILFIELD TOOLS

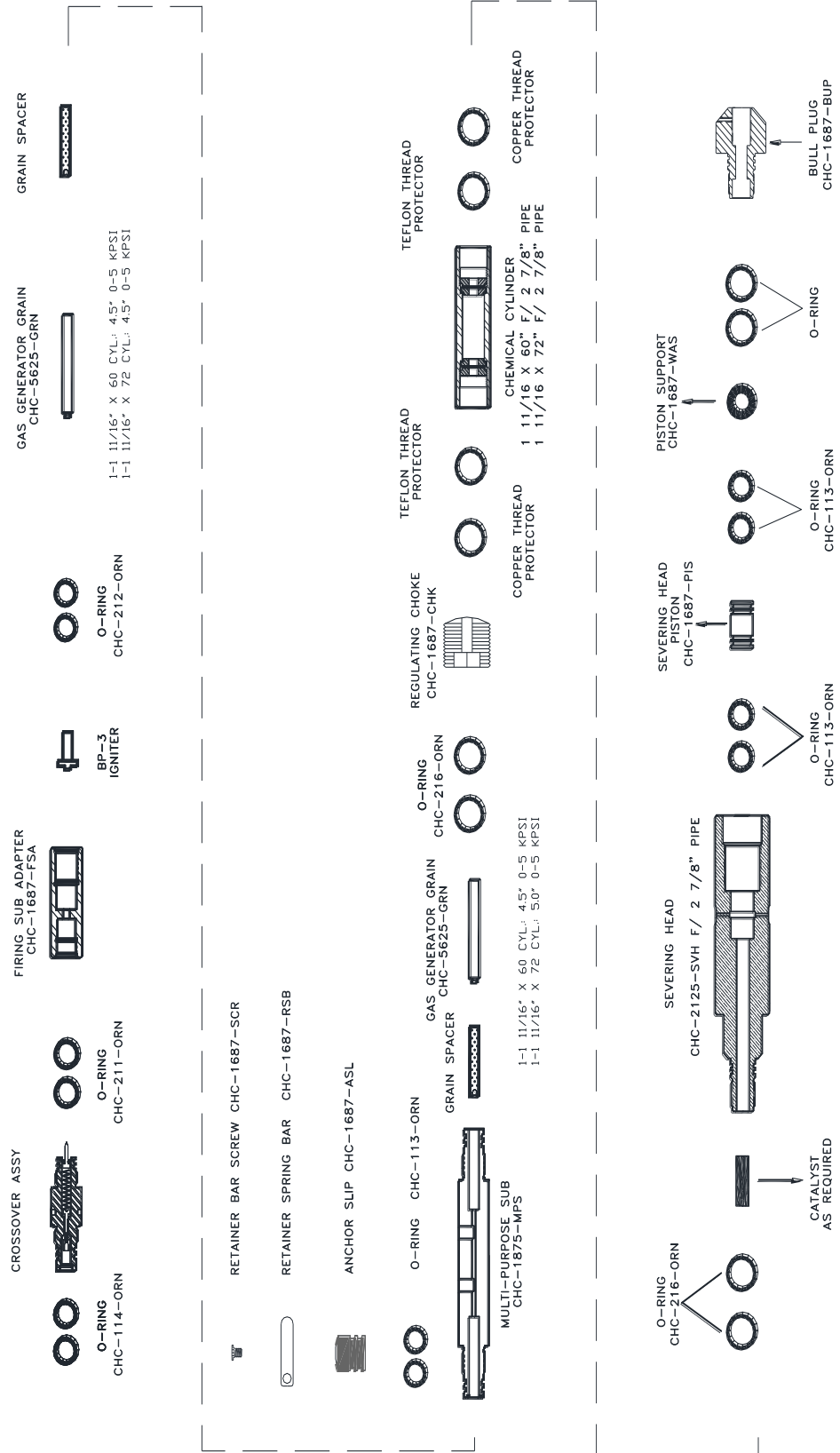
1 11/16" CHEMICAL CUTTER ASSEMBLY F/ 2 3/8" PIPE





DANIEL OILFIELD TOOLS

2 1/8" CHEMICAL CUTTER ASSEMBLY F/ 2 7/8" PIPE



TOOL CLEANING AND MAINTENANCE

1. After each firing, visually check all parts for pressure damage. Anchor Slips can be reused if their upper teeth are not broken or bent by the force applied to them. The Multi-Purpose Sub Slip Bores need to be carefully checked for enlargement after the firing. The Severing Head needs not to be disposed if the Orifices are not enlarged and if the internal Piston Bore is not damaged by the High Velocity flow of the Chemical. Use your Discretion in choosing what parts to expand and what parts can be ran a second firing.
2. Wash all parts with High Pressure Steam water
3. Use a Bench Grinder with a Wheel Brush to polish all external threads and O-Rings Grooves.
4. Use the Wire Brush Set sold by Daniel Oilfield Tools to thoroughly clean all internal threads and O-Ring Bores
5. When the above steps are followed, place all parts in a commercial cleaner tank.
6. Air-dry all parts. Then, Spray with anti-rust fluid such as WD-40

CONVERSION CHART

DIMENSION	METRIC	METRIC/ENGLISH
LENGTH:	1m = 100 cm = 1000 mm 1Km = 1000 m	1m = 39.370 in = 3.2808 ft = 1.0926 yd 1 ft = 12 in = 0.3048* m 1 mile = 5280 ft = 1.6093 km 1 in = 2.54* cm
PRESSURE:	1 Pa = 1 N/m ² 1 kPa = 10 ³ Pa = 10 ⁻³ Mpa	1 Pa = 1.4504 X 10 ⁻⁴ psia = 0.020886 lbf/ft ² 1 psia = 144 lbf/ft ² = 6.894757 kPa
TEMPERATURE:	$T(K) = T(^{\circ}C) + 273.15$	$T(R) = T(^{\circ}F) + 459.67 = 1.8T(K)$ $T(^{\circ}F) = 1.8 T(^{\circ}C) + 32$

* Exact conversion factor between Metric and English units.

HAZARDOUS MATERIAL TABLE

CHEMICAL CYLINDER DATA

BROMINE TRIFLUORIDE UN 1746 CLASS 5.1 PG1 DOT E 7774
OXIDIZER **CORROSIVE** **POISON BY INHALATION**

PART NUMBER	CYLINDER SIZE OD X LENGTH (in)	CHEMICAL VOLUME (CC)	CHEMICAL WEIGHT (KG)
CHC-6875-720	11/16 X 72	90	0.25
CHC-7500-720	3/4 X 72	124	0.35
CHC-1000-480	1 X 48	155	0.43
CHC-1000-720	1 X 72	247	0.69
CHC-1387-480	1 3/8 X 48	225	0.63
CHC-1387-720	1 3/8 X 72	354	1
CHC-1687-360	1 11/16 X 36	277	0.77
CHC-1687-480	1 11/16 X 48	392	1.12
CHC-1687-600	1 11/16 X 60	506	1.43
CHC-1687-720	1 11/16 X 72	621	1.75
CHC-2000-480	2 X 48	608	1.7
CHC-2000-600	2 X 60	790	2.2
CHC-2000-720	2 X 72	970	2.7

GAS GENERATOR GRAIN DATA

FLAMMABLE SOLID ORGANIC N.O.S. (AMMONUM NITRATE)
UN 1325 CLASS 4.1 PG 2

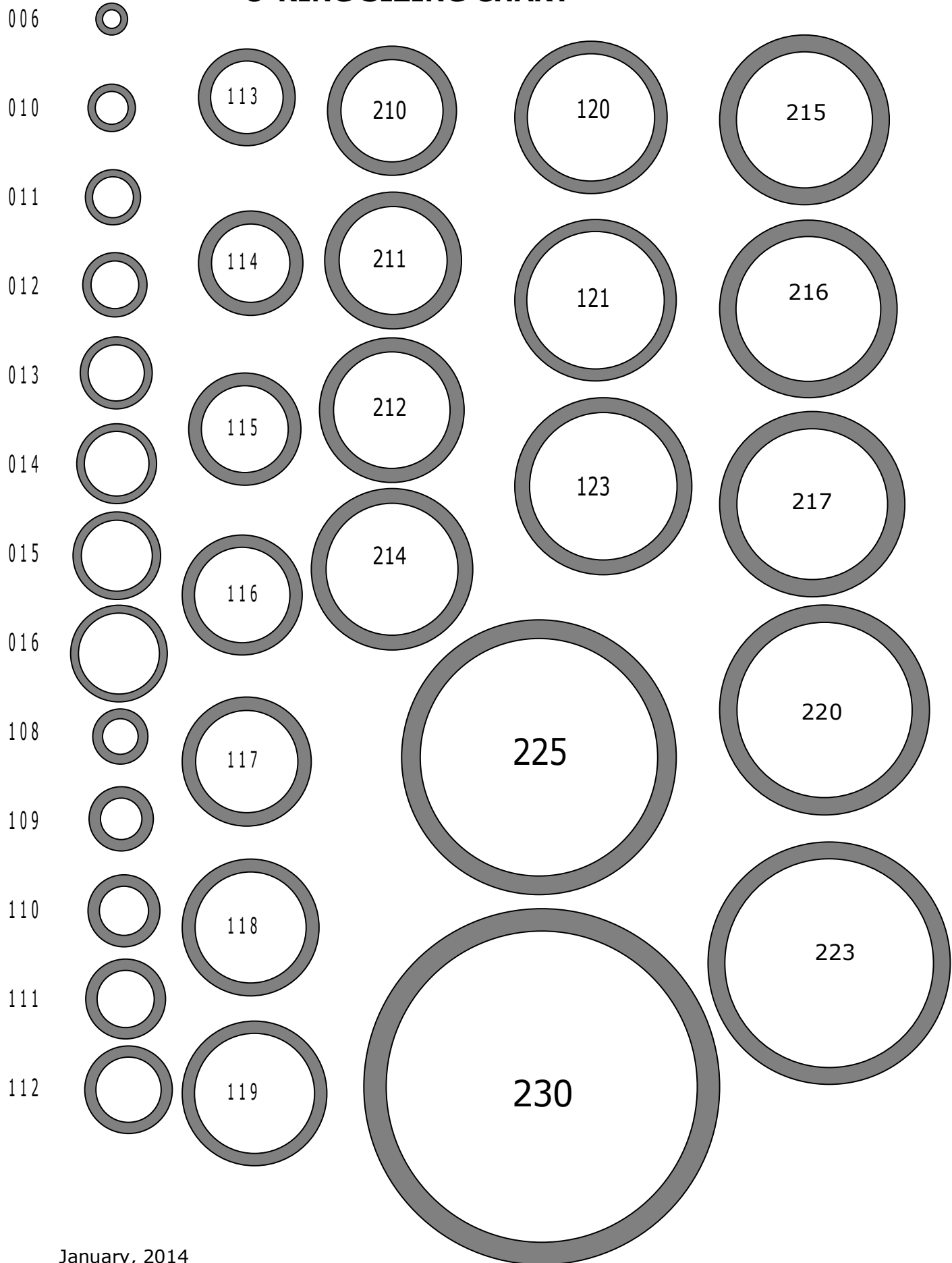
PART NUMBER	GRAIN SIZE OD X LENGTH (in)	GRAIN NET WEIGHT (KG)
CHC-2500-GRN	1/4 X 10	0.0125
CHC-3875-GRN	3/8 X 12	0.035
CHC-5625-GRN	9/16 X 14	0.095

IGNITER DATA

IGNITER UN 0325 CLASS 1.4G PG2

PART NUMBER	EXPLOSIVE NET WEIGHT (KG)
CHC-7500-IGN	0.00075
CHC-1387-IGN	0.001

O-RING SIZING CHART



MATERIAL SAFETY DATA SHEET

PRODUCT - BROMINE TRIFLUORIDE

SUPPLIER:

DANIEL OILFIELD TOOLS

7676 NORTH FREEWAY
SUITE 600
HOUSTON, TEXAS, USA
713-459-2550

CAS #7787-71-5

**EMERGENCY PHONE:
1-800-255-3924**

HEALTH HAZARD DATA

PRODUCT IDENTIFICATION

TRADE NAME AND SYNONYMS: Bromine Trifluoride, Chemical cylinder, UN1746 Class 5.1, Packing Group I

CHEMICAL NAME AND SYNONYMS: Bromine Trifluoride

FORMULA: BrF₃ **CHEMICAL FAMILY:** Halogen Fluoride

TIME WEIGHTED AVERAGE EXPOSURE LIMIT: See last page

SYMPTOMS OF EXPOSURE:

Corrosive and extremely irritating to the upper and lower respiratory tracts, skin, and eyes. BrF₃ hydrolyzes to form hydrofluoric acid, therefore skin burns and mucous membrane irritation are similar to those caused by the acid. Symptoms include tearing of the eyes, cough, difficult breathing, abnormal fluids formation in the nose, mouth and throat. Inhalation of BrF₃ may cause pneumonitis (deep lung inflammation) and pulmonary edema (abnormal fluid buildup in the lungs) which can be fatal. Symptoms of hydrofluoric acid burns are severe pain, redness, possible swelling and tissue destruction.

TOXICOLOGICAL PROPERTIES:

Bromine Trifluoride is irritating and corrosive to all living tissues. Toxic level exposure to skin tissue causes hydrofluoric acid burns and skin lesions resulting in tissue destruction and eventual scarring. Burn activity continues while any residual active fluorides remain. Chemical pneumonitis and pulmonary edema result from exposure to the lower respiratory tract and deep lung. Residual pulmonary malfunction might also occur. Burns of the eye result in lesions and possible loss of vision. Extended low level systemic absorption of fluorides may cause fluorosis, an abnormal calcium accumulation in the bone structure.

RECOMMENDED FIRST AID TREATMENT:

PROMPT MEDICAL ATTENTION IS REQUIRED IN ALL CASES OF OVEREXPOSURE. BROMINE TRIFLUORIDE RESCUE PERSONNEL SHOULD BE EQUIPPED WITH APPROPRIATE PROTECTIVE EQUIPMENT (SELF-CONTAINED BREATHING APPARATUS, ETC.) TO PREVENT UNNECESSARY EXPOSURE.

Inhalation: Move exposed personnel to an uncontaminated area. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Keep victim warm and quiet. Assure that mucus or vomited material does not obstruct the airway by use of positional Drainage. Delayed pulmonary edema may occur. Keep patient under medical observation for at least 24 hours.

Eye Contact: PERSONS WITH POTENTIAL EXPOSURE TO BROMINE TRIFLUORIDE SHOULD NOT WEAR CONTACT LENSES. Flush contaminated eye(s) with large quantities of water. Hold eyelids open with fingers to assure complete flushing. Continue for minimum of 30 minutes.

Skin Contact: Flush affected area with large quantities of water. Remove affected clothing as rapidly as possible. Skin burns may be treated with a calcium gluconate gel or slurry in water or glycerin. This compound binds the active fluorides in an insoluble form and limits burn extension and relieves pain.

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES:

Bromine Trifluoride is a very reactive halogen fluoride. It reacts with virtually all organic and most inorganic substances. Some of the perfluorinated organic substances in their pure form will not be oxidized by Bromine Trifluoride. It reacts violently with water or fuels.

PHYSICAL DATA

BOILING POINT: 258.4°F (125.8°C) **LIQUID DENSITY AT BOILING:** 157.2 lb/ft³ (2513KG/M³)

VAPOR PRESSURE: @70°F (21.1°C) 0.145psia (1.0 kPa) **GAS DENSITY AT 79°F 1 atm :** Liquid

SOLUBILITY IN WATER: Reacts violently **FREEZING POINT:** 47.8°F (8.8°C)

APPEARANCE AND ODOR: Colorless, fuming liquid with a choking, pungent odor.

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): N/A **AUTO IGNITION TEMPERATURE:** N/A

FLAMMABLE LIMITS % BY VOLUME: LEL UEL N/A

EXTINGUISHING MEDIA: Nonflammable

ELECTRICAL CLASSIFICATION: Nonhazardous

January, 2014

DANIEL OILFIELD TOOLS

SPECIAL FIRE FIGHTING PROCEDURES: Fires with bromine Trifluoride as the oxidizer can only be extinguished by shutting off the source of bromine trifluoride. Do not use water, chemical, carbon dioxide or other extinguishing media as these will only add more fuel to the fire.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Reacts violently or explodes on contact with water or organic materials. Combustion Products, including hydrogen fluoride, are toxic and reactive.
STABILITY: Stable **X** Unstable

CONDITIONS TO AVOID:
Reacts violently or explodes on contact with water and organic materials.
INCOMPATIBILITY (Material to avoid):
Water, plastics, hydrocarbons, and other organic materials.
HAZARDOUS DECOMPOSITION PRODUCTS:
Bromine, fluorine, bromine mono-fluoride; hydrogen fluoride in reactions
HAZARDOUS POLYMERIZATION: **CONDITIONS TO AVOID:**
May Occur Will Not Occur **X**

SPILL OR LEAK PROCEDURES

STEPS TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:
Evacuate all personnel from affected area. Use appropriate protective equipment.
Call company technical supervisor or Daniel Oilfield Tools phone number 713-459-2550.
WASTE DISPOSAL METHOD:
All Federal, State and Local Regulations regarding health and pollution should be followed in waste disposal. Contact Daniel Oilfield Tools for specific recommendations. Do not dispose of unused quantities. Contact Tech Manager or Daniel Oilfield Tools for instructions.

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type):
Full face piece cartridge respirator, positive pressure air line or self breathing apparatus.
VENTILLATION: INDOOR - Hood with forced ventilation OUTDOOR - Open area, none required
PROTECTIVE GLOVES: Neoprene Rubber **EYE PROTECTION:** Full face piece respirator
OTHER PROTECTIVE EQUIPMENT:
Safety shoes, eyewash and acid resistant over garments.

SPECIAL PRECAUTIONS*

SPECIAL LABELING INFORMATION:
D.O.T. Shipping Name: Bromine Trifluoride D.O.T. Shipping Class: Oxidizer I.D. No.: UN 1746
D.O.T. Shipping Labels: Oxidizer, corrosive, poison, inhalation hazard
SPECIAL HANDLING RECOMMENDATIONS:
Use in only well-ventilated areas. Do not drag, slide or roll cylinder.
SPECIAL STORAGE RECOMMENDATIONS: Protect cylinders from physical damage. Store in cool, dry, well-ventilated area, and away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C). Full cylinders should be segregated. Use a "first-in-first-out" inventory system.
TIME WEIGHTED AVERAGE EXPOSURE LIMIT:
None established (ACGIH 1984-85). Observation of the exposure limits for hydrogen fluoride, which forms when BrF3 is hydrolyzed, is recommended.
The TWA for HF is 3 molar ppm; the STEL is 6 molar ppm (ACGIH 1984-85)
Note: ACGIH (1984-85) has proposed adoption of a ceiling value of 3 molar for HF.
Local Exhaust: To prevent accumulation above the TWA for hydrogen fluoride
*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which will not be reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.