

**ND6 STORM SHELTER TWISTER RESISTER \$9,500**  
**Proven Reliability and Innovation**



**COMPLETELY SELF-CONTAINED**

- **Structural Vacuum Infused Fiberglass**
- **Back Yard or Under Slab**
- **Self-Contained-Fully Assembled**
- **Chemical Toilet**
- **12 v. Battery Bank**
- **12 v. Air Supply System**
- **12 v. Lighting**

**PROTECTION FROM**

- **F 5 Tornadoes**
- **CAT 5 Hurricanes**
- **Forest Fires**
- **8.5 R Earthquakes**

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### Structural Fiberglass Shelter:

- **Not Hydroscopic** - doesn't absorb water
- **Non Corrosive** - doesn't rust, leach, corrode, or degrade-Lifetime Warranty
- **Watertight** - can be installed below water table
- **Gravity Flange** for installation below high water tables reaching the ground surface
- **Gas tight** - doesn't collect radon gas, methane, and soil odors
- **Non Conductive** - safe from downed power lines and static discharge
- **Bug tight** - no bugs when vents and hatch are closed; screened intake and exhaust when open
- **Manufactured** - not built on site; permit not required, can be moved
- **Strong** – elliptical dome ceiling (pressure vessel) will not implode, unprecedented strength
- **Smooth white interior surface** - easy to clean sanitary and reflects light

US Patents 6,438,907 B1, 63,851,919 B1, 06296693-01, other Patents Pending

### THE ND6 Twister Resister



The ND6 (Natural Disaster for 6 to 10 shelterists) Twister Resister shelter is a totally self-contained 5 psi vertical dome underground storm shelter specifically designed to protect 6-10 people at ground zero of F5 tornados, CAT 5 hurricanes, 8.5 Richter earthquakes, and ground fires with a 2 day life support system. It is specifically designed to operate at ground zero of an F5 tornado. The ND6 includes the structural fiberglass structure, chemical toilet, 12-volt air blower, AGM battery, solar panel/controller, stainless steel screen on inlet and outlet manifolds, 12-volt

LED light, cast aluminum or spring loaded steel hatch, manual jack emergency escape, and gravity flange hold-down for high water tables and the negative pressure of an F5 tornado.

### USING THE SHELTER

The ND6 is large enough in volume at 392 ft<sup>3</sup> with 52 ft<sup>2</sup> floor space to use for *pre-disaster use*. It is equipped with battery power, LED light, toilet, air blower, sitting area, and hazard alert radio, to allow shelterists to stay in the shelter during a tornado watch or warning *before* the tornado reaches your home. Shelterists can still use the shelter by the "OZ" theory where you wait until the last minute when the tornado is in your back yard and then "run as fast as you can" to the shelter and hope you reach the shelter and don't get hurt getting to the shelter. The briefcase size toilet sewage holding tank, is manually taken out of the shelter and dumped into the household toilet and then reconnected to the toilet in the shelter.

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### DESIGN

The ND6 is a third generation Storm Shelter designed and developed by Walton W. McCarthy, M.E., author of PRINCIPLES of PROTECTION, U.S. Handbook of NBC Weapon Fundamentals and Shelter Engineering Standards, Sixth Edition 2012 which is the United State's bible on shelter engineering. He is the principle engineer of Radius Engineering Inc., with over 36 years' experience designing "high-tech" underground shelters. The book is known in the industry as P.O.P. The ND6 was designed using CAD (computer aided drafting), CAE (computer aided engineering), and FEAM (3-dimensional finite element analysis and modeling). The tube dome shape of the ND6 allows it to be a true pressure vessel for resistance to high external pressure and full height water tables. The ND6 shelter system is based on 22 years field experience with McCarthy's successful ES10 and larger sisters, P6 and P10, and CAT 25 fiberglass underground shelters.



### SHELTER CONSTRUCTION

The ND6 is made of structural vacuum infused structural fiberglass manufactured to underground storage tank standards of Underwriters Laboratory, American Society of Testing and Materials, and shelter engineering standards of PRINCIPLES of PROTECTION. Fiberglass was chosen as the optimum material because of its extremely high resiliency and corrosion resistance plus its ability to be shaped into a compound curved structure. The 5 psi (pounds per square inch) external pressure resistance, with no earth arching, is constant over the first 150 years and does not have to be de-rated each year like steel due to corrosion. Fiberglass also forms a complete vapor barrier which provides a dry atmosphere when placed below ground, and it has proven to be sound in the underground storage tank industries. In addition, one of the greatest characteristics of fiberglass is its ability to "remain intact" if overstressed. The inside of the shelter is smooth, curved, and white to create maximum brightness with minimal light. All of these facilities function without outside electricity through the use of a 12-volt, deep-cycle AGM batteries. The inside surface is easily cleaned with common detergents and is easily repaired.



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**SHELTER FACILITIES** The ND6 contains 392 cubic feet with 6.5 to 8 ft. of headroom. This allows for almost normal living and a spacious feeling. There is ample light for reading anywhere in the shelter supplied by an LED light located near the shelter ceiling. Fresh air is brought into the shelter by a 12-volt 40 cfm air blower mounted to a screened air inlet manifold and designed to operate 24 hours per day for approximately 2 days from one battery. The blower supplies many times the breathing volume of air required by adults and produces a complete air change inside the shelter every 10 minutes. This system has the advantage of maintaining constant shelter temperature, constant shelter oxygen levels, constant shelter carbon dioxide levels, and constant shelter moisture levels, plus it prevents overheating. Exhausting of hot, moist, spent air is facilitated through the screened air outlet at the highest point in the shelter where it exits the shelter. This is the most efficient geometry for exhausting spent air. One 100 AH AGM battery provides power for two days. An Absorbed Glass Mat (AGM) battery recombines the hydrogen gas generated during charging into water which drains back into the battery so hydrogen gas is not released into the shelter. The normal loss of battery power is approximately 1.5% per month when the battery charger is not operating. A photovoltaic panel (solar panel) is supplied to maintain the battery charge level. An optional 6-amp 115 volt AC controlling battery charger can be mounted in the shelter to maintain the battery charge from outside AC power. A thru-hull coupling in the shelter entranceway is used to connect an underground cable from the shelter to the nearest power supply. An optional chemical toilet will provide duration with 6 adults of approximately 5 days.



### Shelter Hatch

The standard ND6 is supplied with a commercial aluminum hatch with a 24 in x 24 in clear opening. An optional spring loaded steel hatch is available. Both hatches are recessed below ground level so the hatch is protected from flying debris. Both hatches are opened and closed using a mechanical key on both sides of the hatch.

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### STEEL HATCH



### ALUMINUM HATCH



### HURRICANES

The ND6 is intended to be used by shelterists one day prior to the hurricane reaching your home and one day after the hurricane reaches your home. With seating, bunks, battery power, light, toilet, and radio it will provide a good survival standard of living. The hurricane scale is based on the Saffir-Simpson Hurricane Scale or SSHS. The scale was developed in 1971 by civil engineer Herbert Saffir and meteorologist Bob Simpson who was the director of the US National Hurricane Center. The SSHS scale was introduced to the public in 1973. The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's intensity. The scale is used estimate the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region.

#### Category 1 Hurricane

Winds 74-95 mph. Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage.

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### Category 2 Hurricane

Winds 96-110 mph. Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings.

### Category 3 Hurricane

Winds 111-130 mph. Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtain wall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut off by rising water 3-5 hours before arrival of the center of the hurricane. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences with several blocks of the shoreline may be required.

### Category 4 Hurricane

Winds 131-155 mph. Storm surge generally 13-18 ft above normal. More extensive curtain wall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km).

### Category 5 Hurricane

Winds greater than 155 mph. Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required.

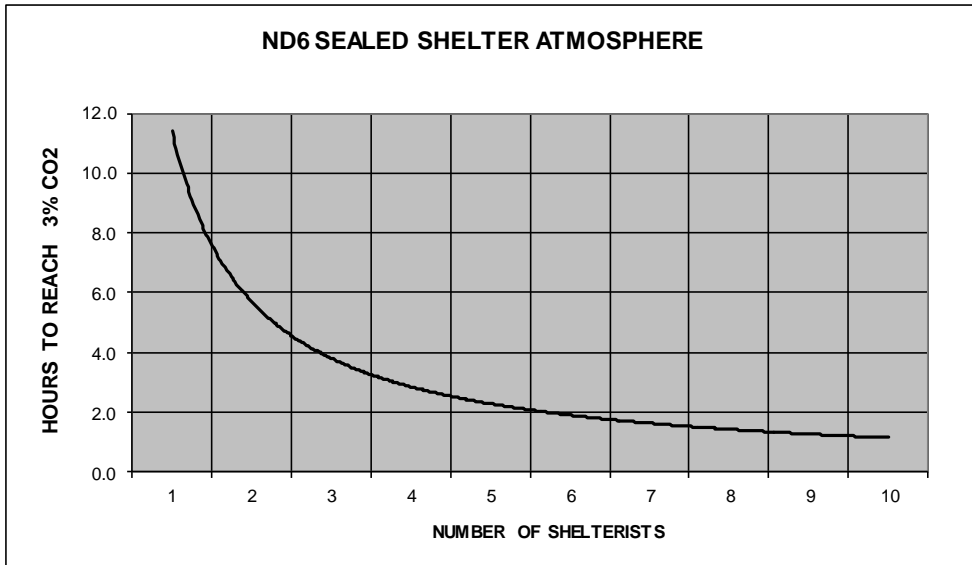
## TORNADOS

Tornado F-Scale	F0	F1	F2	F3	F4	F5
Windspeed (mph)	40-72	73-112	113-157	158-206	207-260	261-318

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### FIRES and SEALED SHELTER ATMOSPHERE



When ground fires are present around the hatch, the air blower should not be turned on to bring in fresh air. During this time, the shelterists must breathe in a *sealed shelter atmosphere*. The safe duration time is based on a 3% carbon dioxide limit. The time it takes for the shelter atmosphere to reach this limit is a function of the number of shelterists, degree of physical activity of the shelterists, and the volume of the shelter above

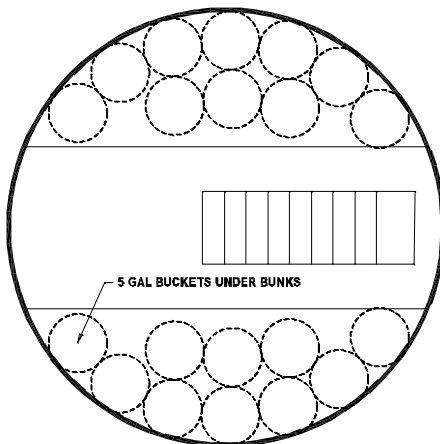
the floor. This duration is shown in the adjacent graph for adults performing mild work producing 0.67 ft<sup>3</sup> of carbon dioxide per hour.

### INTERNAL GENERATOR-OPTIONAL

The ND6 tornado shelter can be equipped with a 5.5 to a 20 KW LP generator with or without an EMP shielded enclosure meeting MIL-288-125A. An underground 1000 gallon liquid propane tank and the 5.5 generator will supply enough power for most conventional homes for up to 6 months. A battery bank and inverter package are also available to extend the power supply.

### STORAGE VOLUME

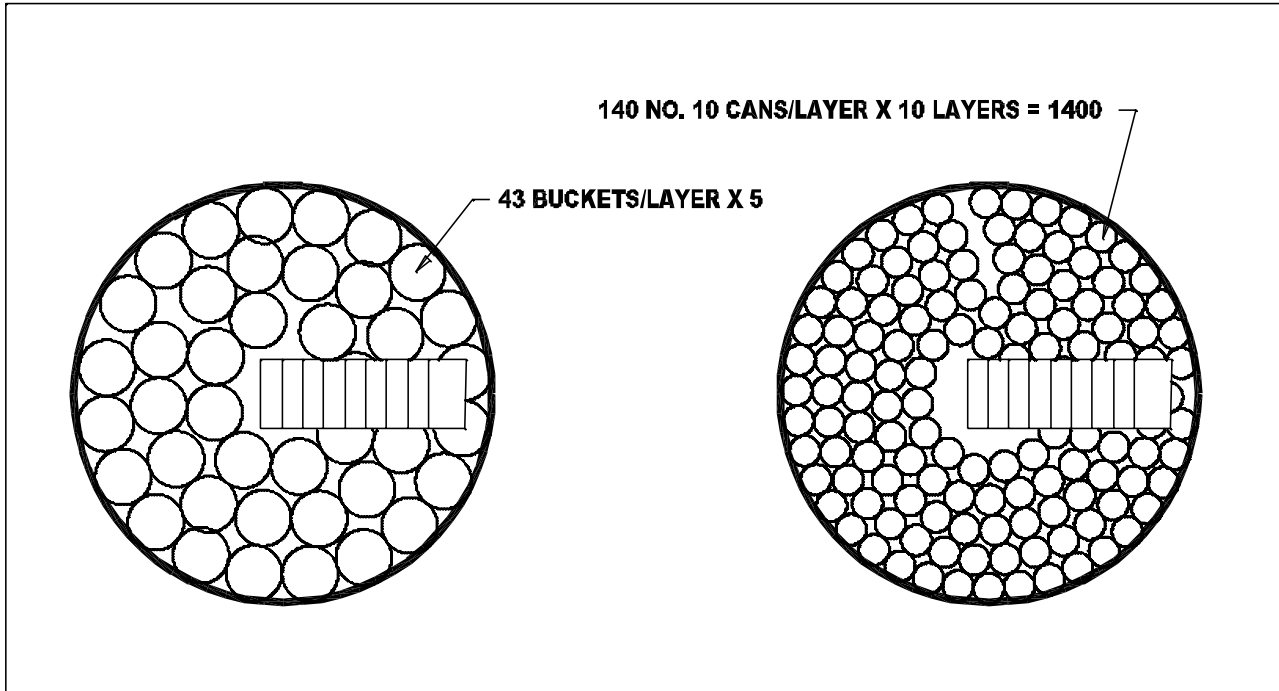
The ND6 with the optional bunk floor plan will allow for storage of approximately twenty 5 gallon buckets under the bunks.



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As an underground storage pod, the ND6 can store 215 five gallon buckets or 1400 No. 10 cans plus approximately 1000 pounds of ammunition and rifles. ``



### SHIPPING AND INSTALLATION

U.S. citizens have a legal right to install a shelter. Under the second amendment of the United States Constitution, U.S. citizens are guaranteed the right to bear arms to provide protection in life threatening situations. Tornadoes, hurricanes, fires and earthquakes fall under this amendment as life threatening forces. A Storm Shelter falls under this classification as a defensive arm. Radius shelters do not have a foundation or running water and therefore usually do not fall under the local building codes.



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### EXCAVATION

The customer hires a contractor to dig a hole with a bottom dimension of 14 feet wide x 14 feet long at a depth of 10 ft. A one to three-inch layer of pea stone is spread in the center of the floor of the hole. The top of the hole should be larger to allow for sloped walls. The excavation usually requires approximately 2 hours. A 17,000 pound excavator or larger should be used to dig the hole and lift the ND6 off of the delivery truck and into the hole. If the shelter is installed in a flood zone, the shelter should be installed so the hatch is one foot above the 100-year flood plain or 2 feet above storm tide surge. Berming can also be used if the shelter is installed in a location which has ledge.



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### SHELTER INSTALLATION

The ND6 should be installed so the hatch is at least one foot above the 100 year flood plain or two feet above the 100 year storm surge. The ND6 can be installed in a back yard or under a garage concrete floor before the footings are poured and installed at the proper height in relation to the concrete slab. Normally the shelter is installed on the center line of each car bay in the garage or between the two bays so the hatch is positioned between the two front tires of the car. This will work as long as the inside distance between the tires is greater than 40 inches. When entering the shelter during Tornado use, the garage door should be opened at least 6 inches to allow fresh air to enter the garage where both inlet and outlet exchange air.

### SHELTER INSTALLATION (summary)

1. The excavator digs a hole that is 14 ft wide, 14 ft. long and 10 ft. deep.
2. 1-3 inches of pea stone or sand is place on the bottom center of the hole and leveled.
3. The excavator lifts the ND6 off of the truck and tracks it back to the excavated hole and lowers the ND6 into the hole.
4. The shelter is leveled at the proper height at the bottom of the hole by shoveling pea stone under the bottom of the shelter gravity flange.
5. The shelter is then backfilled with 10 yards of pea stone. If sand is used, it must be compacted with a "Jumping Jack" or watered. After this stage, the surrounding soil can be used for backfill and must be compacted evenly around the shelter.
6. When the backfilling reaches 12 inches below ground level, the thru-hull coupling can be used to connect the shelter to outside power, telephone lines, antenna lines etc.
7. Backfilling continues to the original ground level. Backfilling usually requires approximately 4 hours.

### WARRANTY

Radius Engineering Inc. Warranties that the fiberglass parts of the ND6 Tornado Shelter will not leak, corrode, or structurally fail for the lifetime of the original owner for the original installation provided that 1) the shelter is not exposed to excessive overpressure 2) The structural parts of the shelter are not modified 3) The shelter is inspected, off-loaded, assembled, backfilled and installed in accordance with the company's installation instructions. 4) structures are not built on top of the shelter. The warranty does not apply to the parts and equipment that Radius Engineering Inc. does not manufacture. These items are covered by the individual manufacturers. Radius Engineering Inc. is continuously improving its product and therefore reserves the right to change any specification without notice. Our liability under this warranty shall be limited to, at our option, repair of the shelter, or delivery of a replacement shelter to the point of original delivery, or refund of the original purchase price. We shall not be liable for any indirect or consequential damages, labor, or installation costs.

### ND6 TECHNICAL DATA

Air blower life ..... 40,000 hours  
Air blower type..... 8-in dia. Reverse curve centrifugal 12-V, 5 watt  
Air blower volume..... 50 cfm @ 0.1 in S.P.  
Air filter ..... none  
Air manifold ..... steel elliptical dome with baffle/drain  
Armor level..... none  
Assembly time ..... 0  
Backfill material required..... pea stone (10 yards)  
Batteries..... 1 - 100 amp hour AGM  
Battery Charger ..... solar panel/controller

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Capacity-adults .....	3 hurricane, 6-10 tornado
Bunks .....	optional
Connector port to other shelters .....	optional 36 in diameter
Duration-blower + light 24hr/day – 6 adults .....	2 days
Emergency escape .....	5,000 lb jack
Entry Type .....	horizontal hatch alum or steel
Excavated hole size .....	14 ft. x 14 ft. – 10 ft. deep
Floor material .....	fiberglass
Floor space .....	52 ft <sup>2</sup>
Fuel Tank.....	none
Hatch cover.....	24 in x 24 in clear opening
Hatch Utility Opening .....	36 x 46 inches
Hatch dome –angle of incidence .....	0 degrees
Hatch latching system.....	4-dog with interior handle and external key
Hatch pressure resistance .....	5 psi neg, 6000 lb neg, 6,000 lb pos
Height Overall .....	10.5 ft.
Hull material .....	structural vacuum infused fiberglass
Hydrostatic pressure (buoyancy) .....	24,461 lbs.
Hydrostatic counter pressure (earth gravity) .....	30,970 lbs S.F. 1.2
Implosion type .....	non-catastrophic
Installation time .....	1 day
Interior color .....	white, flame of 25-50 Type II, ASTM E84
Lighting .....	12 volt -LED 500 lumens
Lift connection .....	Lifting ear on shelter
Max .wind.....	350 mph
Max. Headroom.....	8' - 0"
Minimum headroom .....	6' - 4"
Overall height .....	10.5 ft.
Overall diameter .....	98 inside diameter, 134 in outside diameter
Overpressure – allowable .....	5 psi with no earth-arching effect
Pick Height On trailer.....	13.5 ft.
Power Source.....	Solar Panel with controller
Pressure Rating.....	Static earth @ 140lbs/ft <sup>2</sup> + 5 psi ext press
Protection Factor Gamma.....	0
Protection Factor Neutron .....	0
Sealed shelter atmosphere- 6 adults .....	2 hour
Septic System .....	chemical toilet
Shape .....	vertical tapered cylinder/elliptical dome
Shelter Rating-.....	F5 GZ Tornado, hurricane, 8.5 R earthquake, and fire
Shipping weight.....	1,800 lbs.
Shipping width .....	11 ft.-3 in
Stairwell.....	68 degree 8 in. tread x 12 in rise
Storage volume-under floor.....	0
Thru hull hookups.....	outside 110-volt, antenna cables, solar, etc. (2)
Volume-Total .....	392 ft <sup>3</sup>
Water table allowable height .....	full water table to ground surface
Water Tank .....	none- customer to supply bottled water

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<sup>1</sup> PRINCIPLES OF PROTECTION, The US Handbook Of NBC Weapon Fundamentals and Shelter Engineering Standards, Sixth Edition, Brown Books 2013.