

Champion Engineering Specifications (IPS)

IPS EPOXY FIBERGLASS CONDUIT ABOVE GROUND SPECIFICATIONS

I. References

When a standard or other referenced document referred to in this specification is superseded by an approved revision, the revision shall apply.

II. Listing

The conduit shall be listed by UL, Underwriters Laboratories, to the UL 2515 Above ground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings standard.

All conduit shipped shall contain UL labels.

III. UL-listed Extended Support Spans

The conduit shall be UL listed for the following extended support span lengths.

CONDUIT SIZE	STANDARD WALL (.070")	MEDIUM WALL (.096")	HEAVY WALL (.110")
3/4"	10'	—	—
1"	10'	—	—
1-1/4"	10'	—	—
1-1/2"	10'	—	—
2"	12'	—	—
2-1/2"	12'	—	—
3"	12'	—	—
4"	12'	—	14'
5"	—	13'	14'
6"	—	13'	14'

UL designates Champion Fiberglass MW for 5" and 6" as SW.

IV. Manufacturing

The conduit shall be fiberglass conduit, also known as Reinforced Thermosetting Resin Conduit (RTRC), manufactured using the **single-circuit filament winding process**. Multi-circuit windings are not allowed.

The conduit shall have a winding angle as close as possible to 54.75°. Winding mandrels shall be straight and true so as to produce a non-tapered conduit. Tapering is allowed at the belled end.

The resin system shall be epoxy based, with no fillers, using an anhydride curing agent. The fiberglass shall consist of continuous **E-glass Grade "A" roving**. All additives for increasing flame spread and lowering smoke density shall be halogen free, i.e. not contain chlorine or bromine.

Carbon black shall be used as ultraviolet inhibitor to protect the conduit and fittings during storage and exposure to the outdoors. Conduit and elbows shall be black in color unless a custom color has been sourced by special request.

Curing shall be done using an oven and shall take place in two steps. The first curing zone shall bring the conduit slowly to the gel temperature. The second zone shall post-cure the conduit at no less than 350°F. The pipe has to be properly cured so that when measuring the glass transition temperature with a differential calorimeter, the difference between the first measurement and the second shall not exceed 5°F.

The internal conduit and elbow walls shall be smooth and all fibers embedded in the epoxy.

All elbows shall meet the nominal radius plus or minus 3 inches. The wall thickness shall meet tolerance as shown on the next page and the "Out of Rounds" as shown in NEMA TC 14.

All elbows shall have either straight ends or deep socket PVC couplings.

All conduit bodies shall be compression molded from vinyl ester resin and utilize "Champ-Seal" gasket technology. The gasketing system will consist of a silicone-based gasket that is water-tight, corrosion-resistant and resists impression setting.

All conduits and elbows shall be durably and legibly marked in accordance to NEMA TC 14. In addition, the following information shall be included:

- NEMA TC 14
- UL 2515 (Above Ground)
- Manufacturer and reseller
(if the conduit was modified or bent other than by the manufacturer)
- Date of manufacturing of conduit and elbows
- Elbows shall be marked with the angle and radius
- Special customer markings (per request)

All conduit, elbows and fittings shall be **manufactured in the U.S.A. and marked as such.**

V. Dimensions

Conduit shall be manufactured having **non-tapered sections** (except for integral belled ends).

Conduit shall be manufactured with following nominal dimensions:

SIZE	TYPE	OUTSIDE DIAMETER	INSIDE DIAMETER	WALL THICKNESS
		INCH	INCH	INCH
3/4"	SW	1.050"	0.910"	.070"
1"	SW	1.315"	1.175"	.070"
1-1/4"	SW	1.660"	1.520"	.070"
1-1/2"	SW	1.900"	1.760"	.070"
2"	SW	2.375"	2.235"	.070"
2-1/2"	SW	2.880"	2.740"	.070"
3"	SW	3.500"	3.360"	.070"
4"	SW	4.460"	4.320"	.070"
4"	HW	4.512"	4.320"	.096"
5"	MW	5.572"	5.380"	.096"
5"	HW	5.600"	5.380"	.110"
6"	MW	6.627"	6.435"	.096"
6"	HW	6.655"	6.435"	.110"

VI. Electrical Characteristics

Volume Resistivity	3.8×10^{14} ohm-cm	ASTM D257
Surface Resistivity	1.1×10^{14} ohms	ASTM D257
Dielectric Constant	3.5 (at 10^3 cps)	ASTM D150
Dissipation Factor	0.005 (at 10^3 cps)	ASTM D150
Dielectric Strength	500 volts/mil (19.7 kv/mm)	ASTM D149

VII. Mechanical Characteristics

The conduit shall have following mechanical strength when tested in accordance with referenced test method:

Tensile Strength, Axial	11,000 psi (76 MPa)	ASTM D2105
Compressive Strength	12,000 psi (83 MPa)	ASTM D695
Ultimate Elongation	2% psi (9.6 GPa)	ASTM D2105
Modulus of Elasticity (4" conduit)	1.4×10^{-6} psi (9.6 GPa)	ASTM D2105
Thermal Conductivity	2.0 Btu.in/ft ² .hr.°F (0.30 W/m.K)	ASTM D5930-1

Specific Gravity	1.9	ASTM D792
Glass Content	65–75%	API 15LR
Water Absorption	1% max	ASTM D570
Barcol Hardness	52–56	ASTM D2583
Coefficient of Thermal Expansion	1.2×10^{-5} in/in/°F (2.2×10^{-5} m/m/°C)	ASTM D696

Impact Resistance

The minimum impact resistance values for the conduit shall be as shown in the table below when tested in accordance with ASTM D2444.

SIZE	TYPE	ASTM D2444
3/4"	SW	20 lbs/ft
1"	SW	25 lbs/ft
1-1/4"	SW	30 lbs/ft
1-1/2"	SW	35 lbs/ft
2"	SW	40 lbs/ft
2-1/2"	SW	55 lbs/ft
3"	SW	70 lbs/ft
4"	SW	85 lbs/ft
4"	HW	120 lbs/ft
5"	MW	140 lbs/ft
5"	HW	160 lbs/ft
6"	MW	160 lbs/ft
6"	HW	200 lbs/ft

Stiffness

The minimum conduit stiffness at 5% deflection for all sizes of conduit shall not be less than the values given in the table below when tested in accordance with ASTM D2412.

SIZE	TYPE	ASTM D2412
3/4"	SW	1,500 lb/ft/in ²
1"	SW	1,200 lb/ft/in ²
1-1/4"	SW	850 lb/ft/in ²
1-1/2"	SW	600 lb/ft/in ²
2"	SW	320 lb/ft/in ²
2-1/2"	SW	200 lb/ft/in ²
3"	SW	140 lb/ft/in ²
4"	SW	50 lb/ft/in ²
4"	HW	130 lb/ft/in ²
5"	MW	75 lb/ft/in ²
5"	HW	90 lb/ft/in ²
6"	MW	55 lb/ft/in ²
6"	HW	65 lb/ft/in ²

VIII. Quality Assurance Program

Manufacturer shall have a current Certificate, issued by an independent and accredited company, of compliance with an **ISO 9001:2015 Quality Management System**.

IX. Joining System**A. Conduit Subjected to Changes in Ambient Temperature**

The conduit shall be supplied with a bonded coupling or an integral wound bell on one end and a machined spigot on the other end. A two-part adhesive, epoxy resin system, designed to permanently bond fittings and joints of conduit shall be properly mixed and applied to the spigot end before joining the conduits together. The adhesive shall be available for use in three different ambient temperatures, 70°F, 40°F and 20°F. The adhesive shall be supplied from the same manufacturer of conduit and fittings in order not to void the listing by UL.

B. Constant Ambient Temperature – Gasketed Joining System

The conduit shall be supplied with a gasketed joining system which can be used for concrete encasement as well as direct burial installations. This gasketed conduit shall consist of a three-ribbed gasket made from water-resistant rubber material. The gasket shall be fit into a permanent groove in the belled end of the conduit. Retainer rings etc. are not permitted and shall not be used in order to create the gasket groove.

C. Constant Ambient Temperature – Interference Joining System

The conduit shall be supplied with an interference joining system which can be used for concrete encasement (only). The interference joining system consists of an integral bell and spigot. The spigot end has a buttress type male thread for easy installation into the belled end female mating threads. The tapered buttress threads make the joining system easy to assemble while providing a high pull-out strength of 1,000 lbs. The joining system is concrete tight, but not water tight.

X. Toxicity

The conduit shall not contain any compounds that can release halogens, i.e. chlorine, bromine, fluorine and iodine, in more than trace amounts when burning. Following shall be the maximum values when tested in accordance to ASTM E-800:

GASES	VALUES (MAX PPM)
Hydrogen Chloride	0
Hydrogen Bromide	0
Hydrogen Cyanide	<1
Hydrogen Sulfide	0
Ammonia	0
Aldehydes as HCHO	<10
Oxides of Nitrogen	<50
Carbon Dioxide	<12,500
Carbon Monoxide	<250

XI. Fittings and Accessories

Fiberglass conduit fittings, elbows, and accessories shall be manufactured using one of two manufacturing procedures. The first method shall use the same process, methods, and components as used to manufacture the fiberglass conduit. The second method shall use the compression molding process, Sheet Molding Compound (SMC), for the manufacture of the finished component. The SMC material shall be a vinyl ester resin with +30% reinforcement of glass. The glass fibers should be approximately 1" in length. The SMC material shall be fire resistant to UL 2515 specifications and shall be halogen free.

All conduit bodies shall be supplied with Champion's unique "Champ-Seal" gasketing system. This is a silicone-based, water-tight, corrosion-resistant gasketing system that completely resists impression setting.

XII. Environmental

Manufacturer shall have a current Certificate, issued by an independent and accredited company, of compliance with an **ISO 14001:2015 Environmental Management Systems and Performance**.

XIII. Installation Training

Manufacturer may provide (upon request) contractor installation training for field cutting, joint preparation, joint assembly, field bending and RTRC field cut sealing (with field cutting sealant) at manufacturer's discretion.

IPS EPOXY FIBERGLASS CONDUIT BELOW GROUND SPECIFICATIONS

I. References

When a standard or other referenced document referred to in this specification is superseded by an approved revision, the revision shall apply.

II. Listing

The conduit shall be listed by UL, Underwriters Laboratories, to the UL 2420 IPS (Below Ground) standard.

All conduit shipped shall contain UL labels.

III. UL-listed Extended Support Spans

The conduit shall be UL listed for the following extended support span lengths.

CONDUIT SIZE	STANDARD WALL (.070")	MEDIUM WALL (.096")	HEAVY WALL (.110")
3/4"	10'	—	—
1"	10'	—	—
1-1/4"	10'	—	—
1-1/2"	10'	—	—
2"	12'	—	—
2-1/2"	12'	—	—
3"	12'	—	—
4"	12'	—	14'
5"	—	13'	14'
6"	—	13'	14'

UL designates Champion Fiberglass MW for 5" and 6" as SW.

IV. Manufacturing

The conduit shall be fiberglass conduit, also known as Reinforced Thermosetting Resin Conduit (RTRC), manufactured using the **single-circuit filament winding process**. Multi-circuit windings are not allowed.

The conduit shall have a winding angle as close as possible to 54.75°. Winding mandrels shall be straight and true so as to produce a non-tapered conduit. Tapering is allowed at the belled end.

The resin system shall be epoxy based, with no fillers, using an anhydride curing agent. The fiberglass shall consist of continuous **E-glass Grade "A" roving**. All additives for increasing flame spread and lowering smoke density shall be halogen free, i.e. not contain chlorine or bromine.

Carbon black shall be used as ultraviolet inhibitor to protect the conduit and fittings during storage and exposure to the outdoors. Conduit and elbows shall be black in color unless a custom color has been sourced by special request.

Curing shall be done using an oven and shall take place in two steps. The first curing zone shall bring the conduit slowly to the gel temperature. The second zone shall post-cure the conduit at no less than 350°F. The pipe has to be properly cured so that when measuring the glass transition temperature with a differential calorimeter, the difference between the first measurement and the second shall not exceed 5°F.

The internal conduit and elbow walls shall be smooth and all fibers embedded in the epoxy.

All elbows shall meet the nominal radius plus or minus 3 inches. The wall thickness shall meet tolerance as shown on the next page and the "Out of Rounds" as shown in NEMA TC 14.

All elbows shall have either straight ends or deep socket PVC couplings.

All conduit bodies shall be compression molded from vinyl ester resin and utilize "Champ-Seal" gasket technology. The gasketing system will consist of a silicone-based gasket that is water-tight, corrosion-resistant and resists impression setting.

All conduits and elbows shall be durably and legibly marked in accordance to NEMA TC 14. In addition, the following information shall be included:

- NEMA TC 14
- UL 2420 (Below Ground)
- Manufacturer and reseller
(if the conduit was modified or bent other than by the manufacturer)
- Date of manufacturing of conduit and elbows
- Elbows shall be marked with the angle and radius
- Special customer markings (per request)

All conduit, elbows and fittings shall be **manufactured in the U.S.A. and marked as such.**

V. Dimensions

Conduit shall be manufactured having **non-tapered sections** (except for integral belled ends).

Conduit shall be manufactured with following nominal dimensions:

SIZE	TYPE	OUTSIDE DIAMETER	INSIDE DIAMETER	WALL THICKNESS
		INCH	INCH	INCH
3/4"	SW	1.050"	0.910"	.070"
1"	SW	1.315"	1.175"	.070"
1-1/4"	SW	1.660"	1.520"	.070"
1-1/2"	SW	1.900"	1.760"	.070"
2"	SW	2.375"	2.235"	.070"
2-1/2"	SW	2.880"	2.740"	.070"
3"	SW	3.500"	3.360"	.070"
4"	SW	4.460"	4.320"	.070"
4"	HW	4.512"	4.320"	.096"
5"	MW	5.572"	5.380"	.096"
5"	HW	5.600"	5.380"	.110"
6"	MW	6.627"	6.435"	.096"
6"	HW	6.655"	6.435"	.110"

VI. Electrical Characteristics

Volume Resistivity	3.8×10^{14} ohm-cm	ASTM D257
Surface Resistivity	1.1×10^{14} ohms	ASTM D257
Dielectric Constant	3.5 (at 10^3 cps)	ASTM D150
Dissipation Factor	0.005 (at 10^3 cps)	ASTM D150
Dielectric Strength	500 volts/mil (19.7 kv/mm)	ASTM D149

VII. Mechanical Characteristics

The conduit shall have following mechanical strength when tested in accordance with referenced test method:

Tensile Strength, Axial	11,000 psi (76 MPa)	ASTM D2105
Compressive Strength	12,000 psi (83 MPa)	ASTM D695
Ultimate Elongation	2% psi (9.6 GPa)	ASTM D2105
Modulus of Elasticity (4" conduit)	$1.4 \times 10^{+6}$ psi (9.6 GPa)	ASTM D2105
Thermal Conductivity	2.0 Btu.in/ft ² .hr.°F (0.30 W/m.K)	ASTM D5930-1
Specific Gravity	1.9	ASTM D792
Glass Content	65–75%	API 15LR
Water Absorption	1% max	ASTM D570
Barcol Hardness	52–56	ASTM D2583
Coefficient of Thermal Expansion	1.2×10^{-5} in/in/°F (2.2×10^{-5} m/m-/°C)	ASTM D696

Impact Resistance: ASTM D2444

SIZE	TYPE	ASTM D2444
3/4"	SW	20 lbs/ft
1"	SW	25 lbs/ft
1-1/4"	SW	30 lbs/ft
1-1/2"	SW	35 lbs/ft
2"	SW	40 lbs/ft
2-1/2"	SW	55 lbs/ft
3"	SW	70 lbs/ft
4"	SW	85 lbs/ft
4"	HW	120 lbs/ft
5"	MW	140 lbs/ft
5"	HW	160 lbs/ft
6"	MW	160 lbs/ft
6"	HW	200 lbs/ft

Stiffness at 5% Deflection: ASTM D2412

SIZE	TYPE	ASTM D2412
3/4"	SW	1,500 lb/ft/in ²
1"	SW	1,200 lb/ft/in ²
1-1/4"	SW	850 lb/ft/in ²
1-1/2"	SW	600 lb/ft/in ²
2"	SW	320 lb/ft/in ²
2-1/2"	SW	200 lb/ft/in ²
3"	SW	140 lb/ft/in ²
4"	SW	50 lb/ft/in ²
4"	HW	130 lb/ft/in ²
5"	MW	75 lb/ft/in ²
5"	HW	90 lb/ft/in ²
6"	MW	55 lb/ft/in ²
6"	HW	65 lb/ft/in ²

VIII. Quality Assurance Program

Manufacturer shall have a current Certificate, issued by an independent and accredited company, of compliance with an **ISO 9001:2015 Quality Management System**.

IX. Joining System

A. Conduit Subjected to Changes in Ambient Temperature

The conduit shall be supplied with a bonded coupling or an integral wound bell on one end and a machined spigot on the other end. A two-part adhesive, epoxy resin system, designed to permanently bond fittings and joints of conduit shall be properly mixed and applied to the spigot end before joining the conduits together. The adhesive shall be available for use in three different ambient temperatures, 70°F, 40°F and 20°F. The adhesive shall be supplied from the same manufacturer of conduit and fittings in order not to void the listing by UL.

B. Constant Ambient Temperature – Gasketed Joining System

The conduit shall be supplied with a gasketed joining system which can be used for concrete encasement as well as direct burial installations. This gasketed conduit shall consist of a three-ribbed gasket made from water-resistant rubber material. The gasket shall be fit into a permanent groove in the belled end of the conduit. Retainer rings etc. are not permitted and shall not be used in order to create the gasket groove.

C. Constant Ambient Temperature – Interference Joining System

The conduit shall be supplied with an interference joining system which can be used for concrete encasement (only). The interference joining system consists of an integral bell and spigot. The spigot end has a buttress type male thread for easy installation into the belled end female mating threads. The tapered buttress threads make the joining system easy to assemble while providing a high pull-out strength of 1,000 lbs. The joining system is concrete tight, but not water tight.

X. Toxicity

The conduit shall not contain any compounds that can release halogens, i.e. chlorine, bromine, fluorine and iodine, in more than trace amounts when burning. Following shall be the maximum values when tested in accordance to ASTM E-800:

GASES	VALUES (MAX PPM)
Hydrogen Chloride	0
Hydrogen Bromide	0
Hydrogen Cyanide	<1
Hydrogen Sulfide	0
Ammonia	0
Aldehydes as HCHO	<10
Oxides of Nitrogen	<50
Carbon Dioxide	<12,500
Carbon Monoxide	<250

XI. Fittings and Accessories

Fiberglass conduit fittings, elbows, and accessories shall be manufactured using one of two manufacturing procedures. The first method shall use the same process, methods, and components as used to manufacture the fiberglass conduit. The second method shall use the compression molding process, Sheet Molding Compound (SMC), for the manufacture of the finished component. The SMC material shall be a vinyl ester resin with +30% reinforcement of glass. The glass fibers should be approximately 1" in length. The SMC material shall be fire resistant to UL 2515 specifications and shall be halogen free.

All conduit bodies shall be supplied with Champion's unique "Champ-Seal" gasketing system. This is a silicone-based, water-tight, corrosion-resistant gasketing system that completely resists impression setting.

XII. Environmental

Manufacturer shall have a current Certificate, issued by an independent and accredited company, of compliance with an **ISO 14001:2015 Environmental Management Systems and Performance**.

XIII. Installation Training

Manufacturer may provide (upon request) contractor installation training for field cutting, joint preparation, joint assembly, field bending and RTRC field cut sealing (with field cutting sealant) at manufacturer's discretion.