

Crystal Engineering Safety Guide for Selecting and Using Hose Assemblies and Fittings

WARNING: Failure or improper selection or improper use of Hose Assemblies, or fittings (“Products”) can cause death, personal injury and property damage. Possible consequences of failure or improper selection or improper use of these Products include but are not limited to:

- Fittings thrown off at high speed.
- High velocity fluid discharge.
- Explosion or burning of the conveyed fluid.
- Contact with suddenly moving or falling objects that are controlled by the conveyed fluid.
- Injections by high-pressure fluid discharge.
- Dangerously whipping Hose Assemblies.
- Contact with conveyed fluids that may be hot, cold, toxic or otherwise injurious.
- Sparking or explosion caused by static electricity buildup or other sources of electricity.
- Sparking or explosion while spraying paint or flammable liquids.
- Electrocutation from high voltage electric powerlines.
- Injuries resulting from inhalation, ingestion or exposure to fluids.

Before selecting or using any of these Crystal Engineering Products, it is important that you read and follow the instructions below. None of Crystal Engineering’s Hose Assemblies and Fittings are approved for in flight aerospace applications.

1.0 INSTRUCTIONS

1.1 Scope: This safety guide provides instructions for selecting and using (including installing and maintaining) these products. For convenience, all assemblies made with Hose are called “Hose Assemblies”. All products commonly called “fittings”, “adapters”, or “couplings” are called “Fittings”. This safety guide is a supplement to and is to be used with, the specific Crystal Engineering publications for the specific Hose Assemblies and Fittings that are being considered for use.

1.2 Fail-Safe: Hose Assemblies and Fittings can and do fail without warning for many reasons. Design all systems and equipment in a fail-safe mode, so that failure of the Hose Assembly or Fitting will not endanger persons or property.

1.3 Distribution: Provide a copy of this safety guide to each person that is responsible for selecting or using Hose Assembly and Fitting products. Do not select or use Crystal Engineering Hose Assemblies or Fittings without thoroughly reading and understanding this safety guide as well as the specific Crystal Engineering publications for the products considered or selected.

1.4 User Responsibility: Due to the wide variety of operating conditions and applications for Hose Assemblies and Fittings, Crystal Engineering and its distributors do not represent or warrant that any particular Hose Assembly or Fitting is suitable for any specific end use system. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the Hose Assembly and Fitting.
- Assuring that the user’s requirements are met and that the application presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the Hose Assemblies and Fittings are used.
- Assuring compliance with all applicable government and industry standards.

1.5 Contact: Call Crystal Engineering at 1-805-595-5477 or go to www.crystallengineering.net if you have any questions or require any additional information.

2.0 HOSE ASSEMBLY AND FITTING SELECTION INSTRUCTIONS

2.1 Crystal Engineering does not manufacture Hose Assemblies and Fittings that are specifically designed to be electrically conductive or electrically nonconductive.

2.1.1 Electrical Conductivity: Certain applications require that the Hose Assemblies be nonconductive to prevent electrical current flow. Other applications require the Hose Assemblies/Fitting interface to be sufficiently conductive to drain off static electricity. Extreme care must be exercised when selecting Hose Assemblies and Fittings for these or any other applications in which electrical

conductivity or nonconductivity is a factor. The electrical conductivity or non-conductivity of Hose Assemblies and Fittings is dependent upon many factors and may be susceptible to change. These factors include but are not limited to the various materials used to make the Hose Assemblies and the Fittings, Fitting finish (some Fitting finishes are electrically conductive while others are nonconductive), manufacturing methods (including moisture control), how the Fittings contact the Hose Assemblies, age and amount of deterioration or damage or other changes, moisture content of the Hose Assemblies at any particular time, and other factors.

a. Electrically Conductive Hose Assemblies: Crystal Engineering does not manufacture special Hose Assemblies for certain applications that require electrically conductive Hose Assemblies. These Hose Assemblies may be labeled “Electrically Conductive Airless Paint Spray Hose Assemblies” on its layline and packaging. These Hose Assemblies must be properly connected to appropriate Fittings and properly grounded in order to dissipate dangerous static charge buildup, which occurs in all airless paint spraying applications.

b. Airless Paint Systems Use: Do not use any Crystal Engineering Hose Assemblies for airless paint spraying. Use of any other Hose Assemblies or failure to properly connect the Hose Assemblies can cause a fire or an explosion resulting in death, personal injury, and property damage.

c. CNG Applications: Crystal Engineering does not manufacture special Hose Assemblies for certain compressed natural gas (“CNG”) applications where static electricity buildup may occur. These Hose Assemblies must be properly connected to the appropriate Fittings and properly grounded in order to dissipate dangerous static charge buildup, which occurs in, for example, high velocity CNG dispensing or transfer. Do not use any Crystal Engineering Hose Assemblies for CNG applications where static charge buildup may occur. Use of Crystal Engineering Hose Assemblies in CNG applications or failure to properly connect or ground this Hose Assemblies can cause a fire or an explosion resulting in death, personal injury, and property damage. Care must also be taken to protect against CNG permeation through the Hose Assemblies wall.

d. Aerospace Use: Crystal Engineering does not manufacture special Hose Assemblies for aerospace in flight applications. Aerospace in flight applications employing Hose Assemblies to transmit fuel, lubricating fluids and hydraulic fluids require a special Hose Assemblies with a conductive inner tube. Use of other Hose Assemblies for in flight applications or failure to properly connect or ground this Hose Assemblies can cause a fire or an explosion resulting in death, personal injury, and property damage. These Hose Assemblies for in flight applications must meet all applicable aerospace industry, aircraft engine, and aircraft requirements.

- 2.1.2 Electrically Nonconductive Hose Assemblies:** Certain applications require that the Hose Assemblies be nonconductive to prevent electrical current flow or to maintain electrical isolation. Do not use any Crystal Engineering Hose Assemblies or Fitting for any such application requiring nonconductive Hose Assemblies, including but not limited to applications near high voltage electric lines. For these applications that require Hose Assemblies to be electrically nonconductive, including but not limited to applications near high voltage electric lines, only special nonconductive Hose Assemblies can be used. The manufacturer of the equipment in which the nonconductive Hose Assemblies is to be used must be consulted to be certain that the Hose Assemblies and Fittings that are selected are proper for the application.
- 2.2 Pressure:** Hose Assembly selection must be made so that the published maximum allowable working pressure (MAWP) of the Hose Assemblies is equal to or greater than the maximum system pressure. Surge pressures or peak transient pressures in the system must be below the published maximum allowable working pressure (MAWP) for the Hose Assemblies. Surge pressures and peak pressures can usually only be determined by sensitive electrical instrumentation that measures and indicates pressures at millisecond intervals. Mechanical pressure gauges indicate only average pressures and cannot be used to determine surge pressures or peak transient pressures. Published burst pressure ratings for Hose Assemblies is for manufacturing test purposes only and is no indication that the Product can be used in applications at the burst pressure or otherwise above the published maximum allowable working pressure (MAWP).
- 2.3 Vacuum:** Hose Assemblies used for suction applications must be selected to insure that the Hose Assemblies will withstand the vacuum and pressure of the system.
- 2.4 Temperature:** Be certain that fluid and ambient temperatures, both steady and transient, do not exceed the limitations of the Hose Assemblies. Temperatures below and above the recommended limit can degrade Hose Assemblies to a point where a failure may occur and release fluid. Properly insulate and protect the Hose Assemblies when routing near hot objects (e.g. manifolds). Do not use any Hose Assemblies in any application where failure of the Hose Assemblies could result in the conveyed fluids (or vapors or mist from the conveyed fluids) contacting any open flame, molten metal, or other potential fire ignition source that could cause burning or explosion of the conveyed fluids or vapors.
- 2.5 Fluid Compatibility:** Hose Assembly selection must assure compatibility of the Hose Assemblies tube, cover, reinforcement, and Fittings with the fluid media used. Actual service life can only be determined by the end user by testing under all extreme conditions and other analysis.
- 2.6 Permeation:** Permeation (that is, seepage through the Hose) will occur from inside the Hose to outside when the Hose is used with gases, liquid and gas fuels, and refrigerants (including but not limited to such materials as helium, diesel fuel, gasoline, natural gas, or LPG). This permeation may result in high concentrations of vapors which are potentially flammable, explosive, or toxic, and in loss of fluid. Dangerous explosions, fires, and other hazards can result when using the wrong Hose for such applications. The user must take into account the fact that this permeation will take place and must not use Crystal Engineering Hose Assemblies if this permeation could be hazardous. The user must take into account all legal, government, insurance, or any other special regulations which govern the use of fuels and refrigerants. Never use a Hose even though the fluid compatibility is acceptable without considering the potential hazardous effects that can result from permeation through the Hose Assembly. Permeation of moisture from outside the Hose to inside the Hose will also occur in Hose Assemblies, regardless of internal pressure. If this moisture permeation would have detrimental effects (particularly, but not limited to refrigeration and air conditioning systems), incorporation of sufficient drying capacity in the system or other appropriate system safeguards should be selected and used.
- 2.7 Size:** Transmission of power by means of pressurized fluid varies with pressure and rate of flow. The size of the components must be adequate to keep pressure losses to a minimum and avoid damage due to heat generation or excessive fluid velocity.
- 2.8 Routing:** Attention must be given to optimum routing to minimize inherent problems (kinking or flow restriction due to Hose Assembly collapse, twisting of the Hose Assembly, proximity to hot objects or heat sources).
- 2.9 Environment:** Care must be taken to insure that the Hose Assemblies and Fittings are either compatible with or protected from the environment (that is, surrounding conditions) to which they are exposed. Environmental conditions including but not limited to ultraviolet radiation, sunlight, heat, ozone, moisture, water, salt water, chemicals, and air pollutants can cause degradation and premature failure.
- 2.10 Mechanical Loads:** External forces can significantly reduce Hose Assembly life or cause failure. Mechanical loads which must be considered include excessive flexing, twist, kinking, tensile or side loads, bend radius, and vibration. Use of swivel type Fittings or adapters may be required to insure no twist is put into the Hose Assembly. Unusual applications may require special testing prior to Hose Assembly selection.
- 2.11 Physical Damage:** Care must be taken to protect Hose Assemblies from wear, snagging, kinking, bending smaller than minimum bend radius, and cutting, any of which can cause premature Hose Assembly failure. Any Hose Assembly that has been kinked or bent to a radius smaller than the minimum bend radius and any Hose Assembly that has been cut or is cracked or is otherwise damaged, should be removed and discarded.
- 2.12 Specifications and Standards:** When selecting Hose Assemblies and Fittings, government, industry, and Crystal Engineering specifications and recommendations must be reviewed and followed as applicable.
- 2.13 Hose Assembly Cleanliness:** Hose Assembly components may vary in cleanliness levels. Care must be taken to insure that the Hose Assembly selected has an adequate level of cleanliness for the application.
- 2.14 Fire Resistant Fluids:** Some fire resistant fluids that are to be conveyed by Hose Assemblies require use of the same type of Hose Assemblies as used with petroleum base fluids. Some such fluids require a special Hose Assemblies, while a few fluids will not work with any Hose Assemblies at all. The wrong Hose Assemblies may fail after a very short service. In addition, all liquids but pure water may burn fiercely under certain conditions, and even pure water leakage may be hazardous.
- 2.15 Radiant Heat:** Hose Assemblies can be heated to destruction without contact by such nearby items as hot manifolds or molten metal. The same heat source may then initiate a fire. This can occur despite the presence of cool air around the Hose Assemblies.
- 2.16 Welding or Brazing:** When using a torch or arc-welder in close proximity to hydraulic lines, the hydraulic lines should be removed or shielded with appropriate fire resistant materials. Flame or weld spatter could burn through the Hose Assemblies and possibly ignite escaping fluid resulting in a catastrophic failure. Heating of plated parts, including Hose Assemblies Fittings and adapters, above 450°F (232°C) such as during welding, brazing, or soldering may emit deadly gases.
- 2.17 Atomic Radiation:** Atomic radiation affects all materials used in Hose Assemblies. Since the long-term effects may be unknown, do not expose Hose Assemblies to atomic radiation.
- 2.18 Aerospace Applications:** Do not use any Crystal Engineering Hose Assemblies or Fittings for in flight applications. Do not use any Crystal Engineering Hose Assemblies or Fittings with any other in flight approved Hose Assemblies or Fittings.

3.0 USE OF HOSE ASSEMBLIES AND FITTINGS

- 3.1 Component Inspection:** Prior to use, a careful examination of the Hose Assemblies and Fittings must be performed. All components must be checked for correct style and size, part number, and length. The Hose Assemblies must be examined for cleanliness, obstructions, blisters, cover looseness, kinks, cracks, cuts or any other visible defects. Inspect the Fitting and sealing surfaces for burrs, nicks, corrosion or other imperfections. Do not use any component that displays any signs of nonconformance.
- 3.2 Hose Assemblies and Fitting Assembly or Connections:** Do not assemble a Crystal Engineering Fitting on a Crystal Engineering Hose Assembly that is not specifically listed by Crystal Engineering for that Fitting. Do not assemble a Crystal Engineering Fitting on another manufacturer's Hose Assembly or a Crystal Engineering Hose Assembly on another manufacturer's Fitting unless that combination is expressly approved in the appropriate Crystal Engineering literature for the specific Crystal Engineering product. For Crystal Engineering Hose Assemblies that do not specify a Crystal Engineering Fitting, the user is solely responsible for the selection of the proper Fitting and Hose Assembly combination. Crystal Engineering published instructions must be followed for assembling the Fittings on the Hose Assemblies. Contact Crystal Engineering at 1-805-595-5477, or at www.crystalengineering.net for further information if required.
- 3.3 Reusable/Permanent:** Do not reuse any field attachable (reusable) Hose Assemblies Fitting that has blown or pulled off a Hose Assemblies. Complete Hose Assemblies may only be reused after proper inspection. Do not assemble Fittings to any previously used hydraulic Hose Assemblies that was in service, for use in a fluid power application.

3.4 Pre-Installation Inspection: Prior to installation, a careful examination of the Hose Assemblies must be performed. Inspect the Hose Assembly for any damage or defects. Do not use any Hose Assembly that displays any signs of nonconformance.

3.5 Minimum Bend Radius: Installation of a Hose Assembly at less than the minimum listed bend radius may significantly reduce the Hose Assembly life. Particular attention must be given to preclude sharp bending at the Hose Assembly to Fitting juncture. Any bending during installation at less than the minimum bend radius must be avoided. If any Hose Assembly is kinked during installation, the Hose Assembly must be discarded.

3.6 Twist Angle and Orientation: Hose Assembly installation must be such that relative motion of machine components does not produce twisting.

3.7 Securement: In many applications, it may be necessary to restrain, protect, or guide the Hose Assembly to protect it from damage by unnecessary flexing, pressure surges, and contact with other mechanical components. Care must be taken to insure such restraints do not introduce additional stress or wear points.

3.8 Proper Connection of Ports: Proper physical installation of the Hose Assembly requires a correctly installed port connection insuring that no twist or torque is transferred to the Hose Assembly when the Fittings are being tightened or otherwise during use.

3.9 External Damage: Proper installation is not complete without insuring that tensile loads, side loads, kinking, flattening, potential abrasion, thread damage, or damage to sealing surfaces are corrected or eliminated.

3.10. System Checkout: All air entrapment must be eliminated during hydraulic applications, and the system pressurized to the maximum system pressure (at or below the Hose Assembly maximum allowable working pressure (MAWP)) and checked for proper function and freedom from leaks. Personnel must stay out of potential hazardous areas while testing and using.

3.11 Routing: The Hose Assembly should be routed in such a manner so if a failure does occur, the escaping media will not cause personal injury or property damage. In addition, if fluid media comes in contact with hot surfaces, open flame, or sparks, a fire or explosion may occur.

4.0 HOSE ASSEMBLIES AND FITTING MAINTENANCE AND REPLACEMENT INSTRUCTIONS

4.1 Even with proper selection and installation, Hose Assembly life may be significantly reduced without a continuing maintenance program. The severity of the application, risk potential from a possible Hose Assembly failure, and experience with any Hose Assembly failures in the application or in similar applications should determine the frequency of the inspection and the replacement for the Products so that Products are replaced before any failure occurs. A maintenance program must be established and followed by the user and, at minimum, must include instructions 4.3 through 4.7.

4.2. Visual Inspection - Hose Assembly/Fitting: Any of the following conditions require immediate shut down and replacement of the Hose Assembly:

- Fitting slippage on Hose Assemblies;
- Damaged, cracked, cut or abraded cover (any reinforcement exposed);
- Hard, stiff, heat cracked, or charred Hose Assemblies;
- Cracked, damaged, or badly corroded Fittings;
- Leaks at Fitting or in Hose Assembly;
- Kinked, crushed, flattened or twisted Hose Assemblies; and
- Blistered, soft, degraded, or loose cover.

4.3. Visual Inspection - All Other: The following items must be tightened, repaired, corrected or replaced as required:

- Leaking port conditions;
- Damaged, cracked, cut or abraded o-rings (internal or external);
- Excess dirt buildup;
- Worn clamps, guards or shields; and
- System fluid level, fluid type, and any air entrapment (hydraulic applications).

4.4. Functional Test: Operate the system at maximum operating pressure and check for possible malfunctions and leaks. Personnel must avoid potential hazardous areas while testing and using the system.

4.5. Replacement Intervals: Hose Assemblies and elastomeric (o-ring) seals used on Hose Assembly Fittings and adapters will eventually age, harden, wear and deteriorate under thermal cycling and compression set. Hose Assemblies and elastomeric seals should be inspected and replaced at specific replacement intervals, based on previous service life, government or industry recommendations, or when failures could result in unacceptable downtime, damage, or injury risk.

4.6. Hose Assembly Inspection and Failure: Hydraulic power is accomplished by utilizing high-pressure fluids to transfer energy and do work. Hose, Fittings, and Hose Assemblies all contribute to this by transmitting fluids at high pressures. Fluids under pressure can be dangerous and potentially lethal and, therefore, extreme caution must be exercised when working with fluids under pressure and handling the Hose Assemblies transporting the fluids. From time to time, Hose Assemblies will fail if they are not replaced at proper time intervals. Usually these failures are the result of some form of misapplication, abuse, wear, or failure to perform proper maintenance. When Hose Assemblies fail, generally the high-pressure fluids inside escape in a stream which may or may not be visible to the user. Under no circumstances should the user attempt to locate the leak by "feeling" with their hands or any other part of their body. High-pressure fluids can and will penetrate the skin and cause severe tissue damage and possibly loss of limb. Even seemingly minor hydraulic fluid injection injuries must be treated immediately by a physician with knowledge of the tissue damaging properties of hydraulic fluid. If a Hose Assembly failure occurs, immediately shut down the equipment and leave the area until pressure has been completely released from the Hose Assembly. Simply shutting down the hydraulic pump may or may not eliminate the pressure in the Hose Assembly. Many times check valves, etc., are employed in a system and can cause pressure to remain in a Hose Assembly even when pumps or equipment are not operating. Tiny holes in the Hose Assembly, commonly known as pinholes, can eject small, dangerously powerful but hard to see streams of hydraulic fluid. It may take several minutes or even hours for the pressure to be relieved so that the Hose Assembly may be examined safely. Once the pressure has been reduced to zero, the Hose Assembly may be taken off the equipment and examined. It must always be replaced if a failure has occurred. Never attempt to patch or repair a Hose Assembly that has failed. Consult the nearest Crystal Engineering distributor or Crystal Engineering for Hose Assembly replacement information. Never touch or examine a failed Hose Assembly unless it is obvious that the Hose Assembly no longer contains fluid under pressure. The high-pressure fluid is extremely dangerous and can cause serious and potentially fatal injury.

4.7. Elastomeric (o-ring) seals: Elastomeric (o-ring) seals will eventually age, harden, wear and deteriorate under thermal cycling and compression set. Elastomeric seals should be inspected and replaced.

4.8. Refrigerant gases: Special care should be taken when working with refrigeration systems. Sudden escape of refrigerant gases can cause blindness if the escaping gases contact the eye and can cause freezing or other severe injuries if it contacts any other portion of the body.

4.9. Compressed natural gas (CNG): Do not inspect CNG systems using matches, candles, open flame or other sources of ignition. Leak check solutions should be rinsed off after use.