Technical Bulletin

Basic Considerations for Hydraulic Hose Assemblies

Proper design, selection and installation of hydraulic hose is not difficult if the following pointers are kept in mind. A good cut with a Hyde hose cut-off blade is only one step in the process.

Hose Selection Considerations

The three most common causes of hydraulic hose failure are abuse, misapplication and improper plumbing. By giving consideration to the selection and installation of hose, premature failure can be reduced if not eliminated.

The main points to consider when specifying and/or installing hydraulic hose are:

☑ **Pressure Ratings -** Every hose in a hydraulic system must be able to handle the highest pressure produced by the system. When selecting a hose, be sure to consider possible surges or peaks that may be encountered, as they can be destructive to the hose.

☑ **Temperature Range -** Hydraulic hoses must be able to tolerate both the external temperature and the internal fluid temperature. The maximum operating temperature for which a hose is rated must not be exceeded in order to assure the integrity of the hose. Exposing hose to the maximum temperature and maximum rated working pressure, concurrently, will cause degradation of material compounds, and reduced service life by as much as 80%.

☑ **Fluid Compatibility -** All components of the hose assembly (tube, cover, and couplings) must be compatible with the hydraulic fluid being used. Check a compatibility chart to ensure that the tube compound is compatible with the fluid being used in the system. Consider that other variables, such as elevated temperature, contamination and fluid concentration, can affect compatibility.

☑ **Minimum Bend Radius -** Subjecting a hose to a bend radius smaller than the manufacturer's minimum bend radius recommendation places excessive stress on the reinforcement, opens larger gaps between strands of reinforcement and severely reduces the ability of the hose to withstand pressure. Also, hose bends immediately behind the couplings result in undue stress at the couplings. These are common causes of hose failure.

☑ **Hose Size -** The inner diameter of the hose must be capable of handling the required flow volume. Too small an I.D. for a given volume of flow can result in too high a velocity, excessive fluid turbulence, pressure drop, heat generation, and tube damage. A hose I.D. larger than the recommended size will not affect performance of the machine (but does add weight and cost to the system). Hose O.D. becomes an important consideration whenever hose support clamps are used or the house is routed through a bulkhead.

☑ **Hose Routing -** Route high-pressure hydraulic lines parallel to machine contours whenever possible. This will save money by reducing line lengths and minimizing the number of hard-angle, flow-restricting bends. This can also protect hose lines from external damage and make them easier to maintain and service. Plan house routing to avoid excessive flexing and twisting, and incorporate clamps and sleeves as necessary to restrain hoses and protect them from damage.

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☑ **Hose Lengths -** To determine correct hose length, remember that length will change under pressure through expansion or contraction (typically between 2% to 4%). Give consideration to machine vibration and motion, and the routing design. Allow enough length so that the fittings are not subjected to pull-off forces when parts reach their limits of travel.

Avoid stretching hoses, as this can restrict fluid flow. Avoid clamping hoses at their bends, too allow for length changes during pressurization. High and low pressure lines should not be clamped together.

When replacing hose assemblies, always cut the new hose the same length as the one being removed. If the replacement hose is too short, pressure may cause the host to contract and be stretched, reducing service life.

☑ **Hose and Coupling Compatibility -** The coupling-to-hose interface must be compatible with the hose selected. The proper mating thread end must be chosen so that the connection achieves a leak-free seal. Keep in mind that couplings have limited potential for reuse due to the fact that the threads are typically distorted during assembly.

The best hydraulic hose ever made is useless if it is the wrong hose for the job or if it is assembled or installed improperly. A good hydraulic system features a properly joined hose and coupling assembly, installed in such a way that the hose retains flexibility and is not subjected to abuse. Remember to inspect hoses regularly for leaks and visible damage. By following a good maintenance-replacement program, problems can be avoided before they arise.

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Helpful Hints for Design and Installation

Keep these few pointers in mind when designing your hydraulic hose systems and enjoy a more reliable system that is easier to maintain:

☑ Make hose assemblies long enough to prevent exceeding the minimum bend radius recommendations. Be sure hoses are routed in such a way as to prevent exceeding the minimum bend radius, as well. Bending hose to a smaller radius than is recommended can shorten hose life.

☑ Make hoses long enough to allow for contraction and expansion, thus preventing excessive strain at the hose-to-coupling joint. Hose can elongate up to 2% when pressurized and can contract as much as 4%. That may not sound like a lot, but its enough to lead to hose failure if there is no slack in the hose assembly.

☑ Whenever possible, bend hose in one plane only; avoid multi-plane bending of hose, which can twist and damage the wire reinforcement and reduce the hose's pressure capacity. Twisting a hose by only 5° can reduce its life by up to 70%.

☑ When faced with a multi-plane bend, try to reorient the hose if at all possible. Or try installing a hose clamp between the bends (with enough hose to allow for expansion and contraction on each side of the clamp) to relieve strain on the reinforcing wires of the hose. Finally, try using a single section of hose for each bend, joining them with a hose-to-hose coupling.

☑ Avoid possible abrasion of the hose by eliminating contact with adjacent surfaces. Use support clamps to move hoses off surfaces they may rub against. Metal or fabric sleeves may also be used to prevent abrasion from occurring.

☑ Motion can quickly wear out hoses. Ensure hoses have enough length and are routed well to avoid becoming kinked or bent beyond the minimum bend radius. Consider a swivel joint to reduce the stresses of repeated movement on hoses. Finally, consider hose carriers to prevent tangling, twisting or rubbing when multiple hoses are close to each other in situations where motion occurs.

☑ Excessive heat can shorten hose life by making a hose soft, or, worse yet, causing a hose to become brittle. Keep hoses away from external heat sources. If this is impractical, consider using insulated protective sleeves to help block unwanted heat.

☑ Strive for neatness when laying out and routing hoses. This can help prevent tangling, twisting and rubbing and will also aid in the removal and re-installation of hose assemblies.

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Hose Construction - as specified in SAE J517

SAE Hose Type	Inner Tube	Reinforcement	Cover	Operating Temperature F°
100R1-A	Oil resistant synthetic rubber	One wire braid	Oil resistant synthetic rubber	-40 to 200
100R1-AT	Oil resistant synthetic rubber	One wire braid	Oil resistant synthetic rubber 'non-skive'	-40 to 200
100R2-A	Oil resistant synthetic rubber	Two wire braids	Oil resistant synthetic rubber	-40 to 200
100R2-AT	Oil resistant synthetic rubber	Two wire braids	Oil resistant synthetic rubber 'non-skive'	-40 to 200
100R2-B	Oil resistant synthetic rubber	Two spiral plies and one braid of wire	Oil resistant synthetic rubber	-40 to 200
100R2-BT	Oil resistant synthetic rubber	Two spiral plies and one braid of wire	Oil resistant synthetic rubber 'non-skive'	-40 to 200
100R3	Oil resistant synthetic rubber	Two textile braids	Oil resistant synthetic rubber	-40 to 200
100R4 (suction hose)	Oil resistant synthetic rubber	Textile plies or braids with spiral body wire	Oil resistant synthetic rubber	-40 to 200
100R5	Oil resistant synthetic rubber	Two textile braids separated by one wire braid	Textile braid impregnated with oil resistant synthetic rubber compound	-40 to 200
100R6	Oil resistant synthetic rubber	One textile braid	Oil resistant synthetic rubber	-40 to 200
100R7	Oil resistant thermoplastic	Synthetic fiber	Oil resistant thermoplastic	-40 to 200
100R8	Oil resistant thermoplastic	Synthetic fiber	Oil resistant thermoplastic	-40 to 200
100R9-A	Oil resistant synthetic rubber	Four spiral wire plies	Oil resistant synthetic rubber	-40 to 200
100R9-AT	Oil resistant synthetic rubber	Four spiral wire plies	Oil resistant synthetic rubber 'non-skive'	-40 to 200
100R10-A	Oil resistant synthetic rubber	Four spiral wire plies	Oil resistant synthetic rubber	-40 to 200
100R10-AT	Oil resistant synthetic rubber	Four spiral wire plies	Oil resistant synthetic rubber 'non-skive'	-40 to 200
100R11	Oil resistant synthetic rubber	Six spiral plies of heavy wire	Oil resistant synthetic rubber	-40 to 200
100R12 (high impulse)	Oil resistant synthetic rubber	Four spiral plies of heavy wire	Oil resistant synthetic rubber	-40 to 200
100R13 (high impulse)	Oil resistant synthetic rubber	Multiple spiral plies of heavy wire	Oil resistant synthetic rubber	-40 to 250
100R14-A	PTFE	One braid of 303XX stainless steel wire	None	-65 to 400
100R14-B	PTFE with electrically conductive inner surface	One braid of 303XX stainless steel wire	None	-65 to 400