BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 6.25

PRODUCTION PROCESS STANDARD

Installation of Internal Roller Swage Flared Sleeves and Unions

Issue 6
- This standard supersedes PPS 6.25, Issue 5.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS 6.25 related questions to michael.wright@aero.bombardier.com.
- This PPS is effective as of the distribution date.

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	Quality	

Signed original on file. Validation of paper prints is the responsibility of the user.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for installation of internal roller swage flared sleeves and flared unions.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS must be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

1.1.2 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

1.1.3 Procedure or requirements specified in a Bombardier BAPS, MPS, LES or P. Spec. **do not** supersede the procedure or requirements specified in this PPS.

2 Hazardous Materials

2.1 Before receipt at Bombardier Toronto (de Havilland), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Toronto (de Havilland) Environment, Health and Safety Department. Refer to the manufacturer's MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact the Bombardier Toronto (de Havilland) Environment, Health and Safety Department.

3 References

3.1 PPS 6.10 - Cleaning of Fluid System Components.

3.2 PPS 6.12 - Pressure Testing Hydraulic Components, Fuel and Bleed Air Lines on DHC-7 and Subsequent Aircraft including Learjet Model 45.

3.3 PPS 13.26 - General Subcontractor Provisions.

3.4 PPS 27.05 - Manual Edge Finishing Equipment.

3.5 PPS 31.04 - Degreasing Processes.

3.6 PPS 31.17 - Solvent Usage.

4 Materials and Equipment

4.1 Materials

4.1.1 Internal roller swage flared sleeves and flared unions as specified by the engineering drawing (see Figure 1).

4.1.2 Extreme pressure roller lubricant, high viscosity (e.g., MIL-G-23827, Extreme Pressure Lube #3, etc.) for lubrication of swaging rollers.

4.1.3 SAE 10 non-detergent, phosphate-free oil.

4.1.4 General purpose machine oil (e.g., Kluber Corporation Isoflex MBU Base 15 high speed grease) for maintenance of the automatic swage machine.

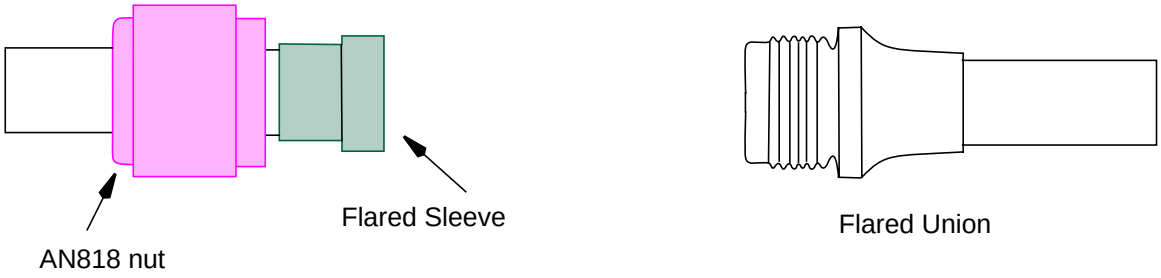


Figure 1 - Internal Roller Swage Flared Sleeves and Unions

4.2 Equipment

4.2.1 Automatic swage machine (e.g., Sierracin/Harrison 6777). It is acceptable to use suitable alternative automatic swaging machines provided the installed internal roller swage flared sleeves and flared unions meet the requirements specified herein without damage to the fittings or tubing; operate alternative automatic swaging machines according to the manufacturer's instructions.

4.2.2 Internal swaging tools, expander assemblies (e.g., as specified in Table 2). When using alternative automatic swaging machines, it is acceptable to use internal swaging tools suitable for the swaging machine.

4.2.3 External swaging tools for fittings (e.g., as specified in Table 4). When using alternative automatic swaging machines, it is acceptable to use external swaging tools suitable for the swaging machine.

4.2.4 Swaging machine gauges which indicate swaging pressure or swaging torque. These gauges must be calibrated at least every three months during periods when production parts are being processed.

4.2.5 Tube micrometer (e.g., Intertest).

4.2.6 Rotary type roller cutter.

5 Procedure

5.1 Tube Preparation

5.1.1 Prepare tubes for swaging as follows:

Step 1. Cut tube ends to length square to the axis of the tubing within ±1°. If installing fittings in the tube shop, cut tube ends using an abrasive saw or hacksaw (e.g., 32 teeth per inch) followed by appropriate end facing equipment. If installing fittings in-situ, cut tube ends using a roller cutter.

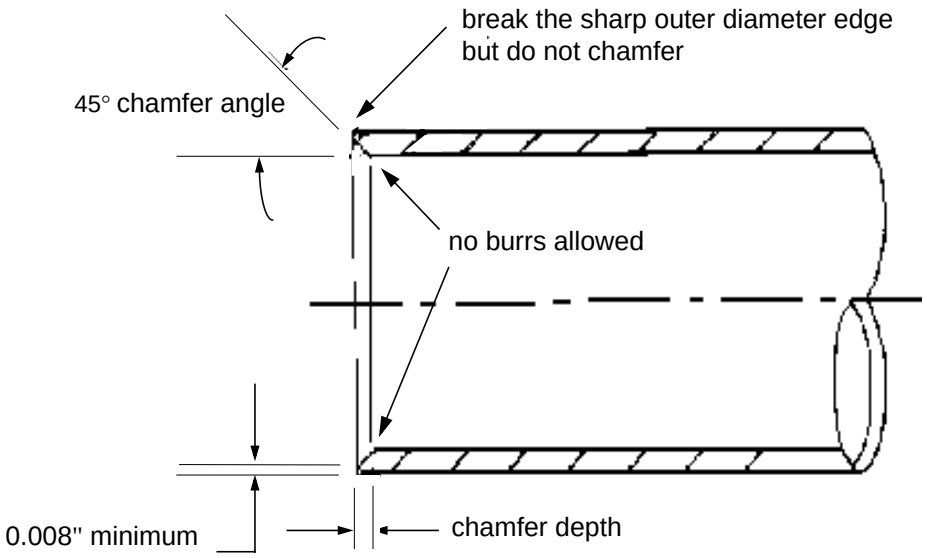
Step 2. Remove any metal chips, dirt, etc. from the tube bore. Flush with solvent according to PPS 31.04, if necessary. Take care to ensure that hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid do not come into contact with solvent blends containing isopropyl alcohol, also known as isopropanol and 2-propanol. Hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid which have been contaminated with solvent blends containing isopropyl alcohol must be cleaned according to PPS 6.10.

Step 3. Remove any tube end distortion, such as that produced by rolling type cutters, to allow insertion of the expander assembly.

Step 4. Deburr and chamfer the tube ends as specified in Table 1 according to PPS 27.05. Remove chips resulting from cutting with compressed air or another non-contaminating method without contaminating the line with debris.

Step 5. Ensure tube surfaces are clean and free of scratches, oil, grease or other foreign material for at least 4" from the tube end. If necessary, clean tubes according to PPS 31.17. Do not use chloride-bearing solvents on titanium tubing. Take care to ensure that hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid do not come into contact with solvent blends containing isopropyl alcohol, also known as isopropanol and 2-propanol. Hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid which have been contaminated with solvent blends containing isopropyl alcohol must be cleaned according to PPS 6.10.

Table 1 - Chamfer Depth



TUBE SIZE	MINIMUM CHAMFER DEPTH	CHAMFER ANGLE
-04 (1/4")	0.006"	45°
-06 (3/8")	0.010"	
-08 (1/2")	0.015"	
-10 (5/8")	0.020"	
-12 (3/4")	0.025"	

5.2 Selection and Preparation of Expander Assemblies

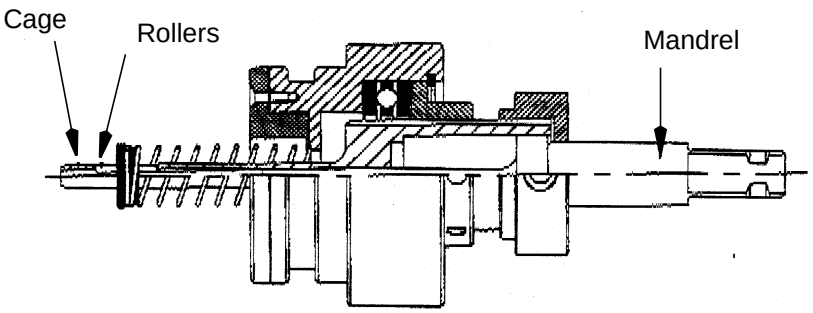
5.2.1 Refer to Table 2 for the appropriate expander assembly for the flared sleeve or union to be swaged. Ensure that expander assemblies are kept in good condition. Expander assemblies in less than optimal condition may tend to leave unacceptable longitudinal, radial or sharp bottomed scratches deeper than 0.001" in the straight rolling area of the inner tube surface. If necessary replace expander assembly components with spare parts as listed in Table 2.

5.2.2 If using the expander assembly for the first time that shift or if the high pressure roller lubricant has become contaminated during use, thoroughly solvent clean the expander rollers and cage according to PPS 31.17. Take care to ensure that hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid do not come into contact with solvent blends containing isopropyl alcohol, also known as isopropanol and 2-propanol. Hydraulic fluid lines and hydraulic system components used with MIL-H-5606 hydraulic fluid which have been contaminated with solvent blends containing isopropyl alcohol must be cleaned according to PPS 6.10.

5.2.3 Before installation in the swaging machine, adjust the expander assembly to the swage length “L” specified in Table 3. This is accomplished by loosening the three set screws in the body of the expander and threading the cage in the required direction. Re-tighten set screws after adjustment.

5.2.4 Install the expander assembly in the swaging machine with the mandrel at the most forward position.

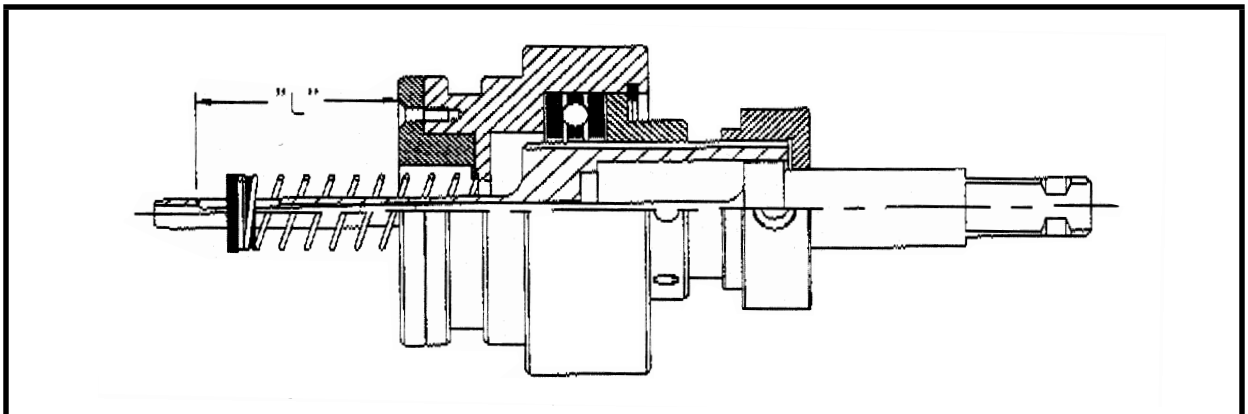
Table 2 - Expander Assembly Selection



FITTING SIZE/ TUBE O.D.	TUBE WALL THICKNESS	EXPANDER ASSEMBLY	MANDREL	ROLLERS	CAGE
-04 (1/4")	0.016"	7520-04016	7521-04016	7522-04016	7519-04016
	0.020"	7520-04020	7521-04020	7522-04020	7519-04020
	0.028"	7520-04028	7339-04028	7340-04028	7338-04028
-06 (3/8")	0.020"	7520-06020	7521-06020	7522-06020	7519-06020
	0.028"	7520-06028	7521-06028	7522-06028	7519-06028
	0.035"	7520-06035	7521-06035	7522-06035	7519-06035
-08 (1/2")	0.026"	7520-08026	7521-08026	7522-08026	7519-08026
-10 (5/8")	0.028"	7175A-10028	7221-10028	7220-10028	7222-10028
	0.033"	7175A-10033	7221-10033	7220-10033	7222-10033
	0.035"	7175A-10035	7221-10035	7220-10035	7222-10035
-12 (3/4")	0.028"	7175A-12028	7221-12028	7220-12028	7222-12028
	0.035"	7175A-12035	7221-16051	7220-12035	7222-12035

Note 1. If the same expander assembly is to be used for both CRES and aluminum tubing, the expander assembly must be thoroughly cleaned according to PPS 31.17 before swaging new material to remove all traces of the previous metal that may become embedded in the tube.

Table 3 - Expander Assembly Set-Up Data



TUBE O.D.	EXPANDER ASSEMBLY	SWAGE LENGTH "L"
-04 (1/4")	7520-04XX	0.900" ± 0.010"
-06 (3/8")	7520-06XX	1.000" ± 0.010"
-08 (1/2")	7520-08XX	1.200" ± 0.010"
-10 (5/8")	7175A-10XX	1.445" ± 0.010"
-12 (3/4")	7175A-12XX	1.445" ± 0.010"

5.3 Swaging Procedure

5.3.1 Swage each fitting as follows:

Step 1. Assemble the external swaging tools (i.e., jaw set) specified in Table 4 in the die housing (see Figure 2).

Step 2. Connect the correctly adjusted expander assembly and the expander cover to the spline drive assembly.

Step 3. Set the torque thumbwheel selectors to the torque setting specified in Table 5.

Step 4. Inspect the rollers and mandrel for damage or wear. Replace them, if necessary.

Step 5. Generously lubricate the expander rollers with clean extreme pressure lubricant. Expander rollers must be lubricated before each swage.

Step 6. Inspect the tube inner diameter for scratches.

Step 7. Insert the tube and fitting and into the external die set assembly. Ensure that the tube butts up against the retainer.

Step 8. Close the jaw and engage the jaw locking mechanism.

Step 9. Press the “SWAGE” button. The mandrel will turn clockwise and the expander assembly will move forward into the tube. Then, the mandrel will move forward and the rollers will swage the tube. After the preset torque value is reached, the machine will stop and reverse the cycle.

Step 10. Turn the jaw selector to the RELEASE position to open the jaws manually.

Step 11. Remove the swaged tube/fitting assembly.

Step 12. Degrease the swaged tube/fitting assembly according to PPS 31.04.

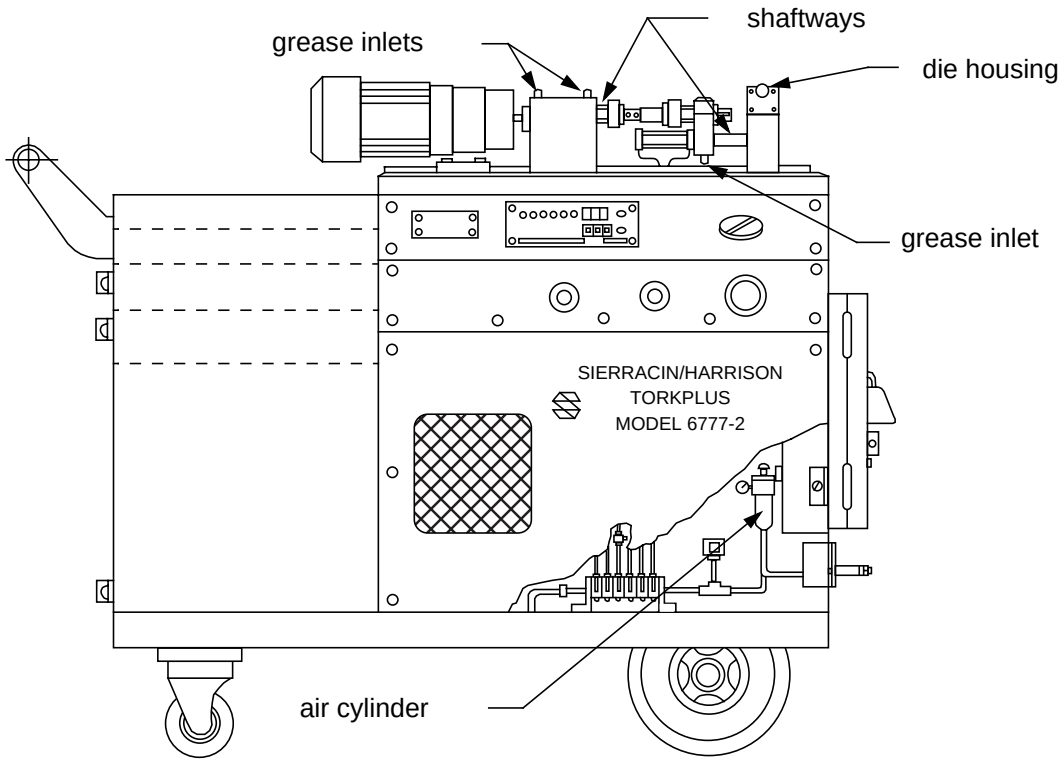


Figure 2 - Components of the Sierracin/Harrison 6777 Swage Machine

Table 4 - External Tooling

FITTING SIZE	Flared Sleeve Jaw Set	Flared Union Jaw Set
-04 (1/4")	7373-04	7518-04
-06 (3/8")	7373-06	7518-06
-08 (1/2")	7373-08	7518-08
-10 (5/8")	7373-10	7518-10
-12 (3/4")	7373-12	7518-12

Table 5 - Required Swage Torque

TUBE MATERIAL	TUBE ALLOY/TYPE	FITTING SIZE	TUBE WALL THICKNESS	TORQUE (in·lbs)
Aluminum	6061-T4	-04 (1/4")	0.035"	4 - 5
		-06 (3/8")	0.028"	5 - 6
		-08 (1/2")	0.028"	8 - 10
		-10 (5/8")	0.035"	15 - 17
		-12 (3/4")	0.035"	12 - 14
CRES	21-6-9	-04 (1/4")	0.016"	5 - 6
		-06 (3/8")	0.020"	11 - 12
		-08 (1/2")	0.026"	18 - 20
		-10 (5/8")	0.033"	20 - 22
	304	-04 (1/4")	0.028"	6 - 7
		-06 (3/8")	0.028"	10 - 11
			0.035"	11 - 12
		-08 (1/2")	0.028"	12 - 14
		-10 (5/8")	0.028"	18 - 20
			0.035"	30 - 33

6 Requirements

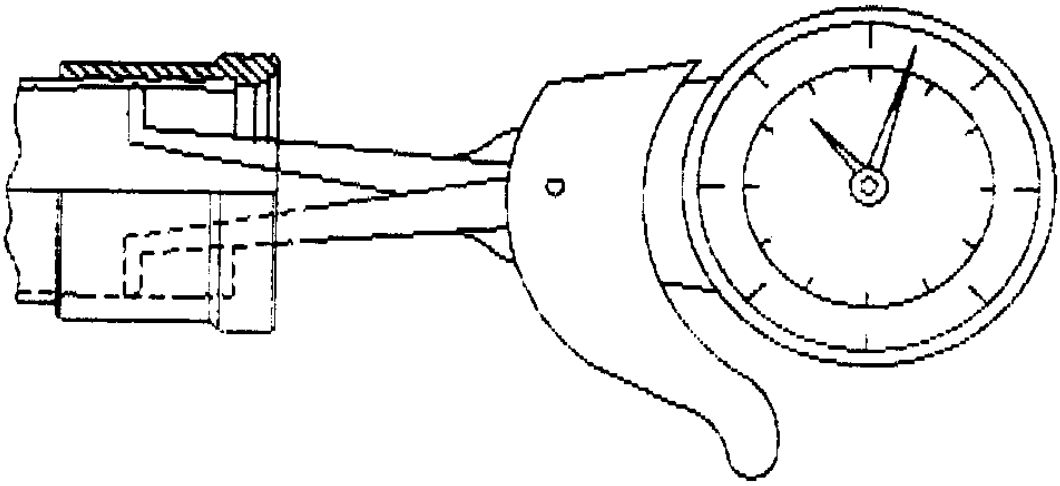
6.1 Visually examine all production parts for the following defects:

- The sealing surfaces of the fittings must not be scratched or otherwise damaged during fabrication. Die marks on the external skirt and shoulder areas of sleeves up to 0.005" in height are acceptable provided that they do not cause interference with the nut.
- The inner surface of the tube in the straight rolling area of the inner tube surfaces must be free from longitudinal, radial or sharp bottomed scratches deeper than 0.001".
- Helical extrusion marks at the extreme end of the rolled area resulting from the first revolutions of the rollers and the subsequent growth of the tube wall are acceptable.
- For aluminum alloy tubing, a slight ridge at the tube end resulting from roller swage action is acceptable.

6.2 Dimensionally examine all production parts using a tube micrometer to ensure that the inside diameter of the tube **under the groove area** meets the requirements specified in Table 6. Take care not to scratch the inside surface of the tube by pulling the extended callipers out of the tube.

6.3 Proof pressure test all tube assemblies according to PPS 6.12 to the pressure specified in Table 7. Tube assemblies may be proof pressure tested at the final assembly stage if testing at the detail stage is not practical.

Table 6 - I.D.A.S. Requirements



TUBE MATERIAL	TUBE ALLOY/TYPE	FITTING SIZE	TUBE WALL THICKNESS	TUBE INNER DIAMETER AFTER SWAGING (I.D.A.S.)
Aluminum	6061-T4	-04 (1/4")	0.035"	0.190" - 0.197"
		-06 (3/8")	0.028"	0.332" - 0.338"
		-08 (1/2")	0.028"	0.458" - 0.465"
		-10 (5/8")	0.035"	0.575" - 0.581"
		-12 (3/4")	0.035"	0.696" - 0.702"
CRES	21-6-9	-04 (1/4")	0.016"	0.225" - 0.231"
		-06 (3/8")	0.020"	0.347" - 0.352"
		-08 (1/2")	0.026"	0.459" - 0.465"
		-10 (5/8")	0.033"	0.577" - 0.583"
	304	-04 (1/4")	0.028"	0.208" - 0.215"
		-06 (3/8")	0.028"	0.336" - 0.341"
			0.035"	0.319" - 0.325"
		-08 (1/2")	0.028"	0.458" - 0.464"
		-10 (5/8")	0.028"	0.581" - 0.586"
			0.035"	0.574" - 0.580"

Table 7 - Proof Pressure Test Data

TUBE MATERIAL	TUBE DIAMETER	TUBE WALL THICKNESS	PROOF PRESSURE
CRES	All	All	4500 psi
Aluminum MIL-T-7081 6061-T6	-04 (1/4")	0.035"	4500 psi
	-06 (3/8")	0.028"	4500 psi
	-08 (1/2")	0.028"	3000 psi
	-10 (5/8")	0.035"	3000 psi
	-12 (3/4")	0.035"	3000 psi

7 Safety Precautions

7.1 Observe general shop safety precautions when performing the procedure specified herein.

7.2 Tooling is subject to extremely high pressure during swaging. Improper use may result in injury and/or tool damage.

8 Personnel Requirements

8.1 Personnel must have a good working knowledge of the applicable procedure and requirements as specified herein and must have exhibited their competency to their supervisor.

9 Recommended Maintenance of Equipment

9.1 Check the oil level at the air filter inside the 6777 swage machine (see Figure 2) once a week and lubricate it with SAE 10 phosphate-free oil. If necessary, lubricate the knob in one turn from the closed position.

9.2 Apply general purpose machine lubricant daily to all shaftways (see Figure 2) and hinge points for smoother movement and to prevent corrosion.

9.3 Every month, fill all grease inlets (see Figure 2) with grease.