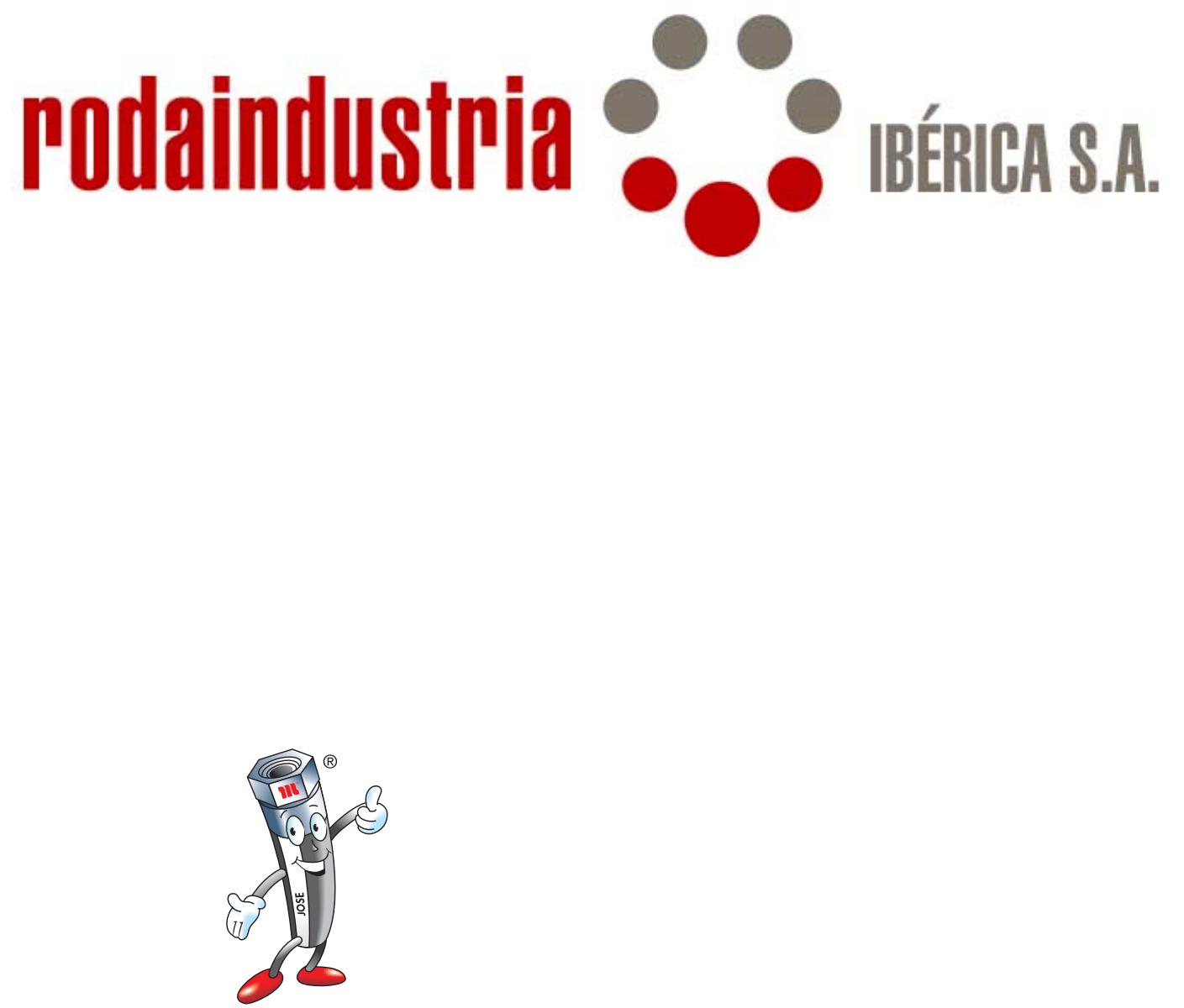




KEY RECOMMENDATIONS

- Referring to the enclosed table, check for the crimping diameter and select the die-set with the closest size.
- The use of die-sets, with diameter significantly smaller than the recommended one, can cause ferrule flowering (i.e. ferrule surface with pinches between the dies) and cracks during the crimping operation.
- The die-set selection should be done ensuring the maximum die landing on the ferrule surface with the minimum flowering effect. This will provide a proper crimping, reducing the risk of ferrule surface cracks and damage of the protective zinc-plating.
- The use of recommended Manuli hoses, fittings, machines and tools ensure an optimized performance results.
- Limited quantities of light paraffinic oils can be used to obtain an easier insert pushing operation.
- Hydraulic assembling procedures should include insert bore collapse control process to check for the assembling performance reliability.

To download this document and get more detailed information, please visit: www.manuli-hydraulics.com
"Assembling information & instructions" and "Assembling Procedure Presentation".

- Manuli offers an integrated package (ref. products range catalogues) composed by:
- HOSES
 - FITTINGS
 - QUICK COUPLINGS
 - ADAPTORS
 - MANIPULATED TUBES
 - ASSEMBLING MACHINES
 - HYDRAULIC AND REFRIGERATION ASSEMBLIES
 - HOSE PROTECTIONS



HYDRAULIC ASSEMBLING PROCEDURE

RECOMMENDATIONS

It is important that hydraulic hose assemblies using Manuli hose and MF fittings (MF2000 & MF3000) are manufactured according to the procedure summarised below. For a full explanation of the procedures refer to the Manuli training competences on www.manuli-hydraulics.com.

- COMPONENTS SELECTION**
Select the specified hoses, ferrules and inserts using the most updated MRI Fluid Connectors Catalogue release.
 - HOSE CUTTING**
Cut squarely the hose (cut angle must be $\leq 3^\circ$). In order to ensure a correct cut (minimum rosetting and tulip effect due to the heat damage to the rubber), it is recommended to use the appropriate blade type:
 - wire spiral, large bore wire braided ($> \text{DN}31$) & Spirtex: use a smooth blade.
 - wire braided small bore ($\leq \text{DN}31$): use a serrated blade
 - Use of scalloped blade (with wavy edge) is acceptable for all hose types.
 - SKIVING OPERATIONS**
When skiving is required, set-up the skiving machine such that the front edge of the knife is set to the correct length (refer to crimping chart: tolerance $\pm 0.5 \text{ mm}$; $\pm 0.02 \text{ inch}$). It is important to remove the maximum thickness of the rubber hose cover without damaging or displacing the reinforcement steel wires.
 - FITTINGS MOUNTING**
 - In case of MF2000 two-piece fittings, mount the ferrule fully onto the hose, and then push the insert fully into the hose.
 - In case of MF3000 one-piece fittings, mark the hose insertion depth (distance from the bottom of the ferrule to its end to be measured by calipers) on the hose cover and push the coupling fully into the hose up to the mark made on the hose cover.
 - Especially in case of large hose sizes and Interlock type fittings the use of a proper pushing machine is recommended to facilitate this operation.
 - DIE-SETS SELECTION FOR MANULI CRIMPING MACHINES**
Choose the die-set closest to and smaller than the specified Crimping Diameter – 0.4 mm .
The 0.4 mm correction is necessary to assure the requested crimping diameter, allowing some ferrule bulging among the dies, when crimping close to the dies closure diameter.
Examples:
 - For achieving a finished crimping diameter of 23.5 mm choose the die-set marked 21 as it is closest to and smaller than $23.5 - 0.4 = 23.1$.
 - For achieving a finished crimping diameter of 24.1 mm don't use the die-set marked 24 but use the die-set marked 21 as it is closest to and smaller than $24.1 - 0.4 = 23.7$.
 - PRELIMINARY SET-UP OF MANULI CRIMPING MACHINE**
Input the crimp diameter setting on the machine to a value equal to specified Crimping Diameter – 0.4 mm .
The 0.4 mm correction is necessary to allow for the elastic rebound of the ferrule.
Examples:
 - In case of a Manuli crimping machine with numerical vernier dial gauge, for achieving a finished crimping diameter close to specified value of 23.5 mm , input a crimp setting of $(23.5 - 21 \times 0.4) \times 100 = 210$.
 - In case of machines with TSD digital control input a crimping setting of $23.5 - 0.4 = 23.1 \text{ mm}$.
 - CRIMPING OPERATIONS**
 - In case of MF2000 two-piece fittings and MF3000 OPNS type one-piece couplings position the entire length of the ferrule inside the dies
 - In case of MF3000 OPS and OPS type one-piece couplings requiring bubble crimp, position the ferrule inside the dies only over the crimp length indicated by a circumferential ring (crimp line) marked on the ferrule.
- WARNING: Double crimping of ferrules covering partial lengths in two or more strikes is not allowed.**
- STEP A. Crimp the next hose assembly end using the same crimp setting imposed during machine set-up phase.
STEP B. Take four measurements across the crimped ferrule at 45° to each other using vernier calipers or micrometers in the middle section of the ferrule crimp length.
STEP C. Calculate the Crimping Diameter as the average of the four measurements taken in the middle.
STEP D. Verify that the actual Crimping Diameter measured is within the specified tolerance range of $(0/-0.2 \text{ mm})$ of that specified in the relevant Manuli MF Crimping Parameters Chart.
STEP E. If the measured crimping diameter is outside the specified crimping diameter limits, it indicates that the crimping machine capability is out of control and the machine must be subjected to maintenance and repair operations.
 - Repeat STEPS A to E for crimping all eventual hose assemblies of the same type.
- WARNING:**
It is not permitted to crimp Manuli hose assemblies to a crimping diameter outside the prescribed range (crimping chart value $\pm 0.2 \text{ mm}$) specified in the latest Manuli MF Crimping Chart.
- INSERT BORE COLLAPSE CHECK**
The insert bore collapse check is an optional procedure intended as a comprehensive evaluation of the goodness of the entire integrated hose assembly process that can include the effect of all impacting parameters:
 - hose dimensional tolerances and rubber properties
 - fittings tolerances and steel properties
 - crimping machine (architecture and type, crimping force and speed, maintenance status, etc.)
 - tooling (die set size, surface finish, etc)
 - cutting, skiving, inserting, positioning, swaging operationsIt permits the assembler to ensure that the components (hose, insert, ferrule, dies, machine) and the assembling operation (correct fitting insertion and ferrule positioning, swaging, etc.) are maintained within acceptable and established quality limits, detecting the effect of any out-of-spec situation.
 - An insufficient collapse may lead blow-off or leakage (especially in "aged" hose assemblies working for a long time in field).
 - Over-collapse resulting from excessive compression of the hose under the fitting may lead to premature hose assembly failures due to reinforcement damage, localised increase in pressure drop due to reduced bore and related heating effects in the fluid of the hydraulic system.For a better monitoring of the assembly process capability, MRI recommends the use of insert bore collapse check procedure described below.

HYDRAULIC ASSEMBLING PROCEDURE

INSERT BORE COLLAPSE CONTROL

- WHAT'S THE INSERT BORE COLLAPSE?**
It is the localised reduction or "collapse" of the insert bore diameter in the effective seal / anchoring area of the fitting due to the compression force applied on the hose wall during the crimping operation. Insert bore collapse indicates the achievement of proper compression level and sealing force.
- WHEN TO MEASURE THE BORE COLLAPSE?**
If the bore collapse procedure is adopted, the measurements have to be taken:
 - at the crimping process set up.
 - when changing hose and/or fitting production lot or during any process variations.
 - at intermediate steps according to process quality control criteria.
- HOW TO MEASURE THE BORE COLLAPSE?**
Main tools suitable to measure bore collapse are the following:
 - GO and NO-GO mandrels
 - a suitable expanding ball or telescopic gauges (traditional telescopic calipers for internal bore measurement)
 - 3-points bore gauging systems (advanced electronic instruments for bore measurements).
 - mechanical/electronic bore callipers can be used to have more precise data

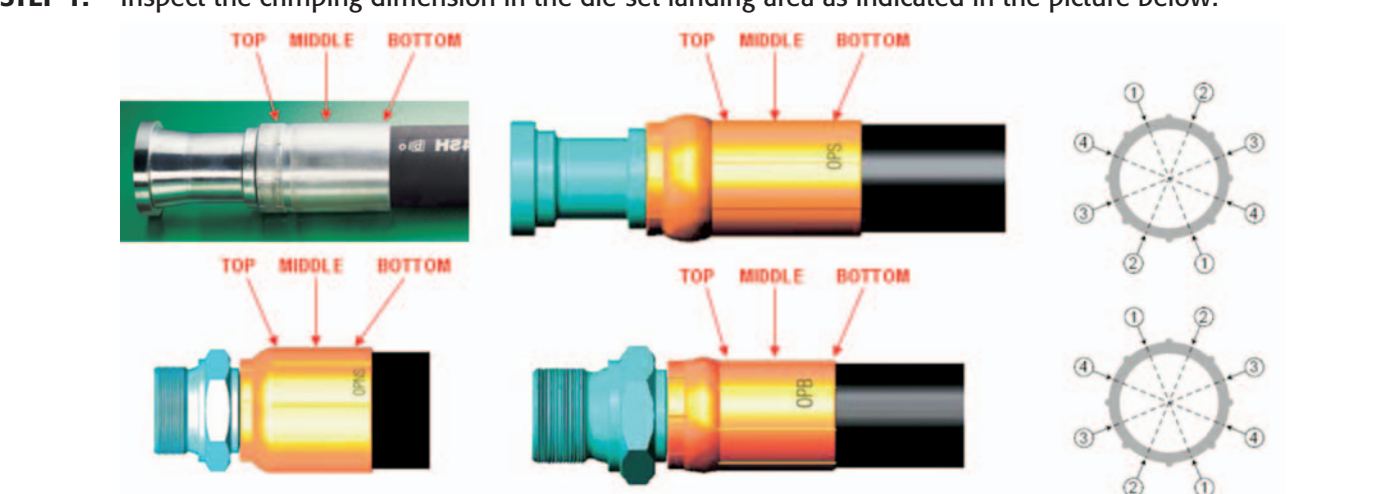
- To measure the insert bore collapse, insert the NO-GO end of the mandrel into the insert tail. The mandrel should stop halfway down the tail. This indicates the minimum collapse has been reached (Fig. 1).
If the assembly is fitted with step-down termination or $90^\circ/45^\circ$ elbows at both ends:
 - Crimp a hose sample.
 - Cut the hose near the fitting area.
 - Insert the bore collapse from the hose side.
- Insert the GO end of the mandrel into the insert tail. The mandrel should pass through the tail (Fig. 2).
- Keep on crimping the assembly or batch of assemblies, using the selected crimp setting and control the bore collapse by suitable statistical frequency.
- The insert collapse should be re-checked in case of changes of hoses, inserts or ferrules batches.
If insert bore collapse is in the recommended range, hose assemblies in correct and assembling operation in control.

- WHAT TO DO IN CASE OF OUT-OF-STANDARD BORE COLLAPSE RESULTS**
If insert bore collapse results outside the recommended tolerance range:
 - Investigate quality level of hoses, fittings, crimping machines and related tools, crimping process, etc.
 - Manuli Sales and Quality departments are at your disposal to fully support you in this investigation.
 - Eventually, change the product lots.

! Crimp diameter should not be adjusted outside the range in the swaging chart without any formal approval by Manuli.

HYDRAULIC ASSEMBLING PROCEDURE

CRIMPING CONTROL STEPS

- STEP 1.** Inspect the crimping dimension in the die-set landing area as indicated in the picture below:
- 
- STEP 2.** Take four measurements across the crimped ferrule at 45° to each other using vernier calipers or micrometers in the middle section of the ferrule crimp length.
- STEP 3.** Calculate the Crimping Diameter as the average of the four measurements taken in the middle.
- STEP 4.** Verify that the actual Crimping Diameter measured is within the specified tolerance range of $(0/-0.2 \text{ mm})$ of that specified in the relevant Manuli MF Crimping Parameters Chart.
- STEP 5.** If the measured crimping diameter is outside the specified crimping diameter limits, calculate the difference between measured and specified value; if this difference is more than 0.2 mm mark an X on this ferrule.
 - If the measured crimping diameter is larger than the specified crimping diameter, reduce the crimp setting appropriately by the difference and recrimp the ferrule, restarting from STEP 1
 - Example:** If the measured value is 23.8 mm with respect to the specified value of 23.5 mm , the difference is 0.3 mm ; mark an X on the ferrule and reduce the crimp setting by $0.3 \times 100 = 30$ in case of Manuli crimping machine with numerical vernier dial gauge and recrimp (*) the same ferrule.
 - If the measured crimping diameter is smaller than the lower limit of the specified crimping diameter, increase the crimp setting appropriately by the difference and proceed to crimp the other end fitting of the assembly, restarting from STEP 1.
- STEP 6.** Calculate the Crimp Ovality as the maximum difference between the four measurements taken in the middle (maximum value – minimum value).
- STEP 7.** If the Crimp Ovality calculated is more than 0.2 mm , mark an X on the ferrule; inspect the machine die-head, springs and dies functioning and replace/repair defective parts.
- STEP 8.** Calculate the Crimp Taper as the difference between the average diameter measured at the top of the ferrule (Termination End side) and the average diameter measured at the bottom of the ferrule
- STEP 9.** Verify that the Ferrule Taper satisfies the following limits:
 - Taper $\leq 0.3 \text{ mm}$ for hose size up to and including DN16 (5/8 inch)
 - Taper $\leq 0.6 \text{ mm}$ for hose size from DN19 (3/4" inch) up to and including DN76 (3 inch)
- STEP 10.** If the Crimp Taper calculated is outside the above limits, mark an X on the ferrule; inspect the machine die-head, springs and dies functioning and replace/repair defective parts.
- STEP 11.** Scrap any assembly marked with X on the ferrule.

Now the crimping machine setup is complete and the machine is ready for crimping other assemblies of the same type.

! * After completion of this preliminary crimping machine set-up phase, changing of crimper setting and double strike of the ferrule to achieve specified crimping diameter is not allowed anymore.

HYDRAULIC ASSEMBLING PROCEDURE

INSERT BORE COLLAPSE CONTROL

- BORE COLLAPSE LIMITS**
Table 1 lists the recommended range of insert bore collapse levels (minimum and maximum values) and related GO and NO-GO gauges for MRI MF2000 inserts (both Multifit and Interlock types).
MRI's crimping diameters are designed to achieve insert bore collapse within the specified range when using the whole integrated product range and the released process technology.

NOMINAL SIZE (inch)	INSERT COLLAPSE (mm)		GO, NO-GO MANDRELS (GAUGES) DIAMETERS (mm)			
	MINIMUM	MAXIMUM	for MULTIFIT TYPE		for INTERLOCK TYPE	
			NO-GO	GO	NO-GO	GO
1/4"	0.40	1.20	3.60	2.75	-	-
3/8"	0.70	1.40	6.25	5.60	-	-
1/2"	0.85	1.70	8.40	7.60	-	-
5/8"	1.00	2.00	11.40	10.55	10.90	10.05
3/4"	1.10	2.20	13.80	12.85	13.10	12.15
1"	1.30	2.60	18.35	17.30	17.55	16.50
1.1/4"	1.45	2.90	24.35	23.25	22.35	21.25
1.1/2"	1.50	3.00	30.30	29.15	28.80	27.65
2"	1.75	3.50	40.00	38.70	39.00	37.70

NOMINAL SIZE (inch)	INSERT COLLAPSE (mm)		GO, NO-GO MANDRELS (GAUGES) DIAMETERS (mm)	
	MINIMUM	MAXIMUM	NO-GO	GO
1/4"	0.30	0.65	3.75	3.20
5/16"	0.35	0.75	5.20	4.60
3/8"	0.40	1.00	6.55	5.85
1/2"	0.50	1.20	8.85	7.95
5/8"	0.60	1.35	11.90	11.00
3/4"	0.65	1.45	14.30	13.40
1"	0.70	1.55	19.20	18.10
1.1/4"	1.00	2.00	24.90	24.05
1.1/2"	1.15	2.30	30.70	29.80
2"	1.25	2.50	40.60	39.60
2.3/8"	1.00	2.00	49.50	48.50
2.1/2"	1.00	2.00	54.50	53.50
3"	0.80	1.80	68.00	67.00

SIZE			INSERT COLLAPSE (mm)	
DN	Dash	Inch	MINIMUM	MAXIMUM
10	- 06	3/8"	0.60	1.20
12	- 08	1/2"	0.70	1.50
19	- 12	3/4"	0.80	1.70

SIZE			INSERT COLLAPSE (mm)	
DN	Dash	Inch	MINIMUM	MAXIMUM
19	- 12	3/4"	1.10	2.20
25	- 16	1"	0.80	1.80
31	- 20	1.1/4"	1.50	2.90
38	- 24	1.1/2"	1.70	3.30
51	- 32	2"	2.70	4.50
63	- 40	2.1/2"	3.00	5.00
76	- 48	3"	3.00	5.00

- APPLICATION FIELD**
 - Insert bore collapse check is **applicable only** to hose assemblies involving the following components:
 - MF2000 two-piece fittings
 - Wire-Spiral hoses
 - 2-Wire-Braided hoses
 - Insert bore collapse check is **not applicable** to hose assemblies involving the following components:
 - MF3000 one-piece fittings
 - 1-Wire-Braided hoses
 - Textile-Braided hoses
 - Refrigeration hoses
 - 2-Wire braided hose DN 5

CRIMPING PARAMETERS CHART

(All dimensions in mm)

Crimping data tolerances: Crimping diameter: 0/-0.2 mm - Skive length: ±0.5 mm

UNIVERSAL • EXTREME																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
HOSE TYPE	DN • Dash Size mm • inches	5 • -03 4.8 • 3/16"												6 • -04 6.4 • 1/4"												8 • -05 7.9 • 5/16"												10 • -06 9.5 • 3/8"												12 • -08 12.7 • 1/2"												16 • -10 15.9 • 5/8"												19 • -12 19.0 • 3/4"												25 • -16 25.4 • 1"												31 • -20 31.8 • 1.1/4"												38 • -24 38.1 • 1.1/2"												51 • -32 50.8 • 2"												60 • -38 60.0 • 2.3/8"																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

NEW PRODUCTS INTRODUCED

Hose type	Remarks
GOLDENISO/21 ANTIWEAR	new line included
GOLDENISO/28 ANTIWEAR	new line included
K-JET	new line included
GOLDENDRILL/3000	new line included
GOLDENDRILL/4000	new line included
GOLDENDRILL/5000	new line included
GOLDENDRILL/7500	new line included
REFRIMASTER/PLUS	new line included
SHIELDMASTER/2PLUS MINE DN 8	new size included

ASSEMBLING PARAMETERS OPTIMISATION & DESIGN CHANGES

Hose type	Remarks	size												
		Dash	-4	-5	-6	-8	-10	-12	-16	-20	-24	-32	-40	-48
		DN	6	8	10	12	16	19	25	31	38	51	63	76
HARVESTER/17	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 14,8 no skive -	MF+M00830-05 15,8 no skive -										
PILOT	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 14,9 no skive -	MF+M00830-05 15,7 no skive -										
MULTITEX	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 15,0 no skive -	MF+M00830-05 16,0 no skive -										
ASTRO/2	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 15,9 no skive -	MF+M00830-05 16,9 no skive -										
HYDROPLAST/HYDROTWIN	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 14,4 no skive -	MF+M00830-05 16,2 no skive -										
TRACTOR/1K	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 14,8 no skive -	MF+M00830-05 15,8 no skive -										
GOLDENISO/21 ANTIWEAR	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 14,8 no skive -	MF+M00830-05 15,8 no skive -										
K-JET	New ferrules M00830	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)	MF+M00830-04 15,3 no skive -	MF+M00830-05 16,2 no skive -										
DIAMONDSPIR DN 63 compact	New compact hose structure	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)											XL+M01800-40 90,5 101 31	
ROCKMASTER/12 DN 19 & 25 GOLDENSPIR/12 DN 19 & 25	Optimisations of crimping diameters	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)						MF+M00920-12 33,5 32 -	MF+M00920-16 41,3 42 -					
ROCKMASTER/2 PLUS DN 19 SHIELDMASTER/2PLUS MINE DN 19	Optimisations of crimping diameters	Fitting (insert + ferrule) crimping diameter (mm) external skive length (mm) internal skive length (mm)						MF+M00920-12 33,2 32 -						

PHASE OUT FROM CRIMPING CHART & PRODUCT RANGE

Hose type	Remarks
SUPERJET DN 10 & 12	phase out
ADLER/2	phase out