

# **Ultrasound Inspection of the CCGS Amundsen Transits**

## **OCEAN GROUP**

Ultrasound Inspection of Transits – Ocean Group

**9 October 2018**



# **3E Ing.**

**Électricité • Énergie • Efficacité**

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## GENERAL INFORMATION

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**Table 1: Revision number**

Rev #	Name	Date of revision	Description
1.0	Gabriel Boivin ing. jr.	2018-10-04	Preliminary issue for customer review

Prepared by : Gabriel Boivin, ing. jr

Signature :  \_\_\_\_\_

Date : 2018-10-04

Verified by: Pierre-Yves Renaud, ing.

Signature :  \_\_\_\_\_

Date : 2018-10-04

*Ocean Group Project Manager* : Doris Chevrier

Ocean Group mandated 3E Ing. to conduct a transit leakage audit for the CCGS Amundsen

Project 18-221 – CCGS Amundsen Transits Ultrasound Inspection

## **1 AUDIT DESCRIPTION**

The Canadian Coast Guard Ship (CCGS) Amundsen Leakage Audit was conducted from Thursday, September 20th until Wednesday, September 26<sup>th</sup>. The CCGS Amundsen was stationed at the Canadian Coast Guard base at Quebec City for repairs.

3E Ing. auditor was accompanied by Mr. Julien Filion, employee of Ocean Group. Mr Filion made sure the auditor could access to the different transits on the ship. He also held the ultrasonic transmitter in the places indicated by the auditor to allow the measurements to be taken.

The transits list to be inspected as part of this audit was provided by Ocean Group (document "F3756-18N044 - Item 4\_Liste des transits.pdf"). 3E Ing. considered this list accurate for the realization of this report.

## 2 AUDIT RESULTS

The table below shows the leaks identified during the audit. A description of the main columns in the table is available at the end of this section.

**Table 2: CCGS Amundsen Transit Leak List**

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
002	HALF	2	20	BST	Above double botton / Platform	69	Port	Ceiling		#
003	HALF	6	5	BST	Above double botton / Platform	69	Port	Ceiling		#
004	HALF	1,75	15	BST	Above double botton / Platform	69	Port	Ceiling	Close influence	#
005	HALF	1,5	10	BST	Above double botton / Platform	69	Port	Ceiling	Close influence	#
007	HALF	2	20	BST	Above double botton / Platform	69	Starboard	Ceiling		#
020	HALF	1	5	MCT	Above double botton	95	Port	Wall		#
021	HALF	Influenced by 020		Roxtec	Above double botton	95	Port	Wall		
023	HALF	6	2	MCT	Above double botton / Platform	95	Starboard	Wall		#
024	HALF	3	15	MCT	Above double botton / Platform	73	Port	Ceiling		#
025	HALF	3	10	MCT	Above double botton / Platform	73	Starboard	Ceiling		#
026	HALF	2	15	MCT	Above double botton / Platform	65	Center	Ceiling		#

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
028	HALF	6	15	MCT	Above double botton / Platform	68	Starboard	Ceiling		#
029	HALF	6	2	MCT	Above double botton / Platform	68	Starboard	Ceiling		#
030-A	HALF	Invalid test		MCT	Above double botton	138	Center	Wall	Cable crosses fuel tank in a pipe of 15 frames. Nothing detected, pipe too long.	
030-B	HALF	Invalid test		MCT	Above double botton	138	Center	Wall		
031	HALF	6	15	MCT	Above double botton	138	Center	Ceiling		#
101	HALF	1	15	Paste	Platform / Main	31	Center	Ceiling		#
102-A	HALF	0,75	15	MCT	Platform	30	Center	Wall		#
102-B	HALF	Influenced by 102-A		MCT	Platform	30	Center	Wall		
102-C	HALF	Influenced by 102-A		Roxtec	Platform	30	Center	Wall		
103	HALF	6	5	MCT	Platform	61	Starboard	Wall		#
104	HALF	4	20	MCT	Platform	61	Starboard	Wall		#
105	HALF	5	15	MCT / Roxtec	Platform	61	Center	Wall		#
106-A	HALF	6	15	MCT	Platform	61	Center	Wall		#
106-B	HALF	6	10	MCT / Roxtec	Platform	61	Center	Wall		#
106-C	HALF	6	20	Roxtec	Platform	61	Center	Wall		#
107-A	HALF	Influenced by 107-D		MCT	Platform	61	Port	Wall		

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
107-B	HALF	Influenced by 107-D		MCT	Platform	61	Port	Wall		
107-C	HALF	Influenced by 107-D		MCT	Platform	61	Port	Wall		
107-D	HALF	2	15	Roxtec Rond	Platform	61	Port	Wall		#
108-B	HALF	2,5	20	MCT	Platform	76	Starboard	Wall		#
109	HALF	0,9	20	MCT	Platform	75	Starboard	Wall		#
110-A	HALF	6	3	MCT	Platform / Main	71	Port	Ceiling		#
110-B	HALF	Influenced by 110-A		MCT	Platform / Main	71	Port	Ceiling		
110-C	HALF	Influenced by 110-A		MCT	Platform / Main	71	Port	Ceiling		
111	HALF	1	20	MCT	Platform	76	Port	Wall		#
112-A	HALF	Influenced by 112-D		MCT	Platform	76	Port	Wall		
112-B	HALF	Influenced by 112-D		MCT	Platform	76	Port	Wall		
112-C	HALF	Influenced by 112-D		MCT	Platform	76	Port	Wall		
112-D	HALF	1	15	MCT / Roxtec	Platform	76	Port	Wall		#
113-A	HALF	3	15	MCT	Platform	76	Center	Wall		#
113-B	HALF	Influenced by 113-A		MCT	Platform	76	Center	Wall		
113-C	HALF	Influenced by 113-A		MCT	Platform	76	Center	Wall		

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
114-A	HALF	3	15	MCT	Platform	76	Center	Wall		#
114-B	HALF	Influenced by 114-A		MCT	Platform	76	Center	Wall		
114-C	HALF	Influenced by 114-A		MCT	Platform	76	Center	Wall		
115	HALF	Influenced by 116-A		MCT	Platform	76	Center	Wall		
116-A	HALF	3	10	MCT	Platform	76	Center	Wall		#
116-B	HALF	Influenced by 116-A		MCT	Platform	76	Center	Wall		
116-C	HALF	Influenced by 116-A		MCT	Platform	76	Center	Wall		
117-A	HALF	Influenced by 117-D		MCT	Platform	95	Starboard	Wall		
117-B	HALF	Influenced by 117-D		MCT	Platform	95	Starboard	Wall		
117-C	HALF	Influenced by 117-D		MCT	Platform	95	Starboard	Wall		
117-D	HALF	1	15	MCT	Platform	95	Starboard	Wall		#
117-E	HALF	Influenced by 117-D		MCT	Platform	95	Starboard	Wall		
117-F	HALF	Influenced by 117-D		MCT	Platform	95	Starboard	Wall		
118-A	HALF	Influenced by 118-E		MCT	Platform	95	Port	Wall		
118-B	HALF	Influenced by 118-E		MCT	Platform	95	Port	Wall		



Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
118-C	HALF	Influenced by 118-E		MCT	Platform	95	Port	Wall		
118-D	HALF	Influenced by 118-E		MCT	Platform	95	Port	Wall		
118-E	HALF	1	5	MCT	Platform	95	Port	Wall		#
118-F	HALF	Influenced by 118-E		MCT	Platform	95	Port	Wall		
118-G	HALF	Influenced by 118-H		MCT	Platform	95	Port	Wall		
118-H	HALF	1	5	MCT et Rostek	Platform	95	Port	Wall		#
119-A	HALF	Influenced by 119-E		MCT	Platform / Main	120	Center	Ceiling		
119-B	HALF	Influenced by 119-E		MCT	Platform / Main	120	Center	Ceiling		
119-C	HALF	Influenced by 119-E		MCT	Platform / Main	120	Center	Ceiling		
119-D	HALF	Influenced by 119-E		MCT	Platform / Main	120	Center	Ceiling		
119-E	HALF	1	15	MCT et Rostek	Platform / Main	120	Center	Ceiling		#
120	HALF	1	20	MCT	Platform / Main	45	Center	Ceiling		#
121	HALF	1	15	MCT	Main / Superior	59	Center	Ceiling		#
122	HALF	1	30	MCT et Rostek	Platform	139	Center	Wall	Connector hole without insulation	#
123-A	HALF	1	10	MCT et Rostek	Platform / Main	140	Center	Ceiling		#

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
123-B	HALF	Influenced by 123-A		MCT et Rostek	Platform / Main	140	Center	Ceiling		
124-A	HALF	6	5	Roxtec	Platform / Main	155	Center	Wall		#
124-B	HALF	Influenced by 124-A		Roxtec	Platform / Main	155	Center	Wall		
200-A	HALF	1	15	MCT	Main	3	Center	Wall		#
200-B	HALF	Influenced by 200-A		MCT	Main	3	Center	Wall		
201	HALF	1	15	MCT	Main	3	Starboard	Wall	Door influence	#
202-A	HALF	4	15	MCT	Main	30	Starboard	Wall		#
202-B	HALF	Influenced by 202-A		MCT	Main	30	Starboard	Wall		
203	HALF	1	15	MCT	Main / Superior	61	Center	Wall		#
204	HALF	1	10	MCT	Main	61	Port	Wall		#
206	HALF	1	10	MCT et Rostek	Main	95	Starboard	Wall		#
207	HALF	6	5	MCT	Main	95	Port	Wall		#
208	HALF	Invalid test		MCT	Main	123	Starboard	Wall	Air leak nearby	
209-A	HALF	Influenced by 209-F		MCT	Main	123	Center	Wall		
209-B	HALF	Influenced by 209-F		MCT	Main	123	Center	Wall		
209-C	HALF	Influenced by 209-F		MCT	Main	123	Center	Wall		
209-D	HALF	Influenced by 209-F		MCT	Main	123	Center	Wall		

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
209-E	HALF	Influenced by 209-F		MCT	Main	123	Center	Wall		
209-F	HALF	1	15	MCT / Roxtec	Main	123	Center	Wall		#
209-G	HALF	1	10	MCT / Roxtec	Main	123	Center	Wall		#
210	HALF	3	15	MCT	Platform	123	Center	Wall	Door influence	#
213-A	HALF	6	15	MCT	Platform / Main	166	Center	Ceiling		#
213-B	HALF	Influenced by 213-A		MCT / Roxtec	Platform / Main	166	Center	Ceiling		
214	HALF	1	10	MCT / Roxtec	Main	165	Center	Wall		#
215	HALF	6	10	MCT	Main	185	Center	Wall	Door influence	#
300	HALF	Influenced by the door		Roxtec	Superior	14	Center	Wall		
302	HALF	Influenced by the door		MCT	Superior	36	Port	Wall	Permeable door	
303	HALF	Influenced by the door		MCT	Superior	41	Port	Wall	Permeable door	
304	HALF	6	10	Roxtec	Superior	51	Port	Wall	Permeable door	#
305	HALF	2	15	MCT	Superior	13	Center	Wall		#
401	HALF	6	10	Roxtec	Vessel	81	Center	Wall	Permeable door	#
X-002	HALF	1	15	N/A	Above double botton	61	Port	Wall		#
X-003	HALF	2	20	N/A	Above double botton	61	Port	Wall		#
X-006	HALF	1	5	N/A	Above double botton	95	Center	Wall		#
X-007	HALF	1	15	N/A	Above double botton	95	Center	Wall		#

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
X-100	HALF	0,75	10	N/A	Platform	30	Center	Wall	Pipe not fully welded	#
X-101	HALF	3	15	N/A	Platform	18	Center	Wall		#
X-102	HALF	Influenced by 107-D		N/A	Platform	61	Port	Wall		
X-104	HALF	1	25	N/A	Platform	76	Port	Wall	Presence of a hole nearby	#
X-105	HALF	1,25	15	N/A	Platform	76	Port	Wall		#
X-106	HALF	2	10	N/A	Platform	95	Starboard	Wall		#
X-107	HALF	Influenced by 118-E		N/A	Platform	95	Port	Wall		
X-108	HALF	Influenced by 119-E		N/A	Platform / Main	120	Center	Ceiling		
X-109	HALF	6	10	N/A	Platform / Main	120	Center	Ceiling		#
X-200	HALF	6	5	Gray paste	Main / Superior	19	Center	Ceiling		#
X-201	HALF	3	15	Gray paste	Main	127	Center	Wall		#
X-202	HALF	Influenced by the door		Gray paste	Main	130	Center	Wall	Permeable door	
X-203	HALF	Influenced by the door		Gray paste	Main	152	Center	Wall	Permeable door	
X-204	HALF	Influenced by the door		Gray paste	Main	169	Center	Wall	Permeable door	
X-205	HALF	Influenced by the door		Gray paste	Main	176	Center	Wall	Permeable door	

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
X-206	HALF	Influenced by the door		Gray paste	Main	176	Center	Wall	Permeable door	
X-207	HALF	Influenced by the door		Gray paste	Main	152	Port	Wall	Permeable door	
X-208	HALF	Influenced by the door		Gray paste	Main	51	Port	Wall	Permeable door	
X-209	HALF	Influenced by the door		Gray paste	Main	51	Port	Wall	Permeable door	
X-210	HALF	4	10	Gray paste	Main	31	Starboard	Wall	Permeable door	#
X-211	HALF	Influenced by the door		Gray paste	Main	46	Center	Wall	Permeable door	
X-212	HALF	1	15	N/A	Main	76	Center	Wall		#
X-213	HALF	1	15	N/A	Main	94	Center	Wall		#
X-214	HALF	Influenced by the door		N/A	Main	108	Center	Wall	Permeable door	
X-300	HALF	6	20	N/A	Superior	10	Center	Wall	Permeable door	#
X-303	HALF	Influenced by the door		N/A	Superior	15	Center	Wall	Permeable door	
X-304	HALF	1	15	N/A	Superior	14	Center	Wall		#
X-305	HALF	1	5	N/A	Superior	15	Center	Wall		#
X-307	HALF	6	10	N/A	Superior	36	Port	Wall	Permeable door	#
X-308	HALF	6	10	N/A	Superior	41	Port	Wall	Permeable door	#
X-309	HALF	2	15	Gray paste	Superior	27	Port	Wall		#
X-310	HALF	1	10	Gray paste	Superior	25	Center	Wall		#

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
X-311	HALF	Influenced by the door		Gray paste	Superior	95	Port	Wall	Permeable door	
X-312	HALF	Influenced by the door		Gray paste	Superior	80	Port	Wall	Permeable door	
X-313	HALF	Influenced by the door		Gray paste	Superior	95	Starboard	Wall	Permeable door	
X-314	HALF	1	5	Gray paste	Superior / Main	117	Center	Ceiling		#
X-316	HALF	6	25	Gray paste	Superior / Main	119	Center	Wall	Permeable door	#
X-317-A	HALF	1	5	Gray paste	Superior / Embarcation	117	Center	Ceiling		#
X-317-B	HALF	1	5	Gray paste	Superior	117	Center	Ceiling		#
X-318	HALF	Influenced by the door		Gray paste	Superior	119	Center	Wall	Permeable door	
X-319	HALF	Influenced by the door		Gray paste	Superior	80	Center	Wall	Permeable door	
X-320	HALF	4	10	N/A	Superior	108	Center	Wall		#
X-321	HALF	6	2	N/A	Superior	90	Port	Wall		#
X-400-A	HALF	1	20	Gray paste	Vessel / Officer	126	Center	Wall		#
X-400-B	HALF	1	20	Gray paste	Vessel / Officer	126	Center	Wall		#
X-401	HALF	2	10	N/A	Vessel	65	Center	Wall	Leak connector second from the	#

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
									bottom from the left	
X-402	HALF	1	20	Red paste and N/A	Vessel	69	Center	Wall		#
X-403	HALF	2	20	No paste	Vessel	80	Center	Wall		#
X-404	HALF	1	20	Red paste	Vessel	76	Center	Wall		#
X-405	HALF	6	20	Gray paste	Vessel	68	Center	Floor		#
X-407	HALF	3	15	Gray paste	Vessel	71	Center	Floor		#
X-408	HALF	6	10	Gray paste	Vessel	73	Center	Floor		#
X-409	HALF	1	15	Gray paste	Vessel	72	Center	Ceiling		#
X-410	HALF	6	10	Gray paste	Vessel	73	Center	Ceiling		#
X-411	HALF	2	20	N/A	Vessel	82	Center	Ceiling	Leak new connector	#
X-412	HALF	4	10	Gray paste	Vessel	76	Center	Ceiling		#
X-413	HALF	6	5	Gray paste	Vessel	98	Port	Ceiling		#
X-414	HALF	6	5	Gray paste	Vessel	117	Port	Wall	Door influence	#
X-415	HALF	6	2	Gray paste	Vessel	119	Center	Ceiling		#

Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
X-416	HALF	6	2	Gray paste	Vessel	98	Port	Floor		#
X-500	HALF	2	5	Gray paste	Officer / Navigation bridge	126	Center	Wall		#
X-501	HALF	2	15	Gray paste	Officer / Navigation bridge	123	Center	Wall		#
X-502	HALF	2	15	Gray paste	Officer / Navigation bridge	103	Center	Wall		#
X-503	HALF	6	15	Gray paste	Officer / Navigation bridge	107	Center	Wall		#
X-600	HALF	1	30	Gray paste	Crawl space	127	Center	Wall		#
X-601	HALF	Influenced by the door		No paste	Crawl space	127	Center	Wall	Permeable door	
X-602	HALF	Influenced by the door		N/A	Navigation bridge	120	Center	Wall	Permeable door	
X-603	HALF	1	15	N/A	Navigation bridge	110	Center	Wall		#
X-604	HALF	Influenced by the door		No paste	Navigation bridge	120	Center	Wall	Permeable door	
X-605	HALF	1	30	No paste	Navigation bridge / Crawl space	135	Port	Ceiling		#
X-606	HALF	1	30	No paste	Navigation bridge / Crawl space	141	Center	Ceiling		#
X-607	HALF	1	30	No paste	Navigation bridge / Crawl space	141	Center	Ceiling		#
X-608	HALF	1	30	No paste	Navigation bridge / Crawl space	135	Starboard	Ceiling		#



Transit #	Full/Half	Gain	Reading	Transit Type	Floor	Frame #	Side	Location	Note	Importance
X-609	HALF	1	30	No paste	Navigation bridge / Crawl space	135	Starboard	Ceiling		#
X-610	HALF	1	30	No paste	Navigation bridge / Crawl space	130	Port	Ceiling		#
X-611	HALF	1	30	No paste	Navigation bridge / Crawl space	130	Port	Ceiling		#
X-612	HALF	1	30	No paste	Navigation bridge / Crawl space	130	Port	Ceiling		#
X-613	HALF	1	30	No paste	Navigation bridge / Crawl space	131	Starboard	Ceiling		#
X-614	HALF	1	30	No paste	Navigation bridge / Crawl space	131	Starboard	Ceiling		#
X-615	HALF	1	10	No paste	Navigation bridge / Crawl space	131	Center	Ceiling		#
X-616	HALF	1	30	No paste	Navigation bridge / Crawl space	131	Center	Ceiling		#
X-617	HALF	1	30	No paste	Navigation bridge / Crawl space	131	Center	Ceiling		#
X-700B	HALF	1	5	N/A	Afterdeck	126	Center	Floor		#

**Transit #:** This column represents the leak identification number. Each leak was marked onsite by a label with the leak identification number and its importance.

**Full / Half:** This column indicates whether the meter was on full gain (Full) to detect smaller leaks in very quiet environments or if the gain was low (Half) for more adjustment accuracy.

**Gain:** The gain indicates the potentiometer setting for the measurement. This potentiometer allows the adjustment of the signal amplification. It is an indicator of the leak importance.

**Transit Type / Level / Frame / Side / Location:** These columns indicate the type and location of transits where leaks were detected.

**Importance:** A color scale has been added in the last column to allow a quick assessment of the relative importance of the leaks. The smallest leak listed is indicated in yellow and the largest is indicated in red. The other leaks are located between yellow and red depending on their importance. The more a leak is important, the more its color tends to red.



It is important to mention that the audited environment may influence measurements and affect leak detection. For example, if the transit is in a very noisy place, it is possible that some leaks are not detected. In addition, a small leak near a much larger one may not be detected.

### 3 REPAIRING LEAKS

The following section outlines recommended steps to fix the leaks for each type of transit. Additional information on repairs is also available in the Appendices.

**Roxtec** : For repair, the first step is to remove all the blocks and start the installation again by following all the steps:

1. Clean the transit frame of any dust.
2. Lubricate the inner surfaces of the frame with Roxtec Lubricant.
3. Adapt the blocks for the size of the cables.
4. There must be just a 0.1-1mm gap between the two halves of blocks when pressed around a cable.
5. Lubricate the outer and inner surfaces of the block.
6. Install them in accordance with the transit installation plan.
7. After finishing a block floor, insert a stay-flat between each floor.
8. Once all the blocks have been inserted, lubricate the sides of the wedge and insert it always in front of a stay plate.
9. Tighten the wedge screws while respecting the tightening level of the model.

**MCT** : For repair, the first step is to remove all the blocks and start the installation again by following all these steps:

1. Clean the transit frame of any dust.
2. Lubricate the inner surfaces of the frame with MCT lubricant.
3. Adapt the blocks for the size of the cables.
4. Lubricate the outer and inner surfaces of the block.
5. Install them in accordance with the transit installation plan.
6. After finishing a block floor, insert a stay-flat between each floor.
7. Once all the blocks are installed, insert the compress pads and tighten.
8. Make sure the space above the compress pads is 32-33mm.
9. Lubricate the pad compress and the frame.
10. Insert the wedge and screw until there is only 12 and 15 mm of the screw.

**BST** : For repair, the first step is to remove all the blocks and start the installation again by following all these steps:

1. Clean the transit frame of any dust.
2. Lubricate the inside surfaces of the frame with lubricant BST.
3. Use blocks suited to the size of the cables.
4. Install them in accordance with the transit installation plan.
5. After finishing a block floor, insert a stay-flat between each floor.
6. Once all the blocks have been inserted, lubricate the sides of the wedge and insert it in front of a stay plate.
7. Tighten the wedge screw.

**Paste :** For repair, the first step is to remove the paste and start the installation again by following all these steps:

1. Clean the surface of any contaminant
2. Install MPACT filter and marine band
3. Apply MFS Marine Firestop Seals
4. Smooth the surface with a trowel, knife or damp cloth before it starts to dry.

## 4 MEASURING DEVICE

The leak tester used for the audit is the UL-101 from CTRL Systems Inc. This device is well known and proven to be remarkably accurate. The latter is used both in industry and in the military sector and even with NASA. In addition to the detection of leaks in transits, this device also allows the inspection and diagnosis of "Bearings" by ultrasound emitted by a bad roll and compressed air leaks.



Figure 1: UL-101 CTRL Systems Inc. Leak tester

## **5 CONCLUSION AND RECOMMENDATIONS**

As part of the audit, 3E Ing. identified 191 leaks from the CCGS Amundsen transits. These leaks were located and categorized according to their importance. 3E Ing. recommends to take action to repair these leaks.

As indicated in the audit results table, some watertight doors were leaking which prevented some measurements. 3E Ing. recommends checking the tightness of the watertight doors.



## **A-1 TRANSITS REPARING METHODS**

## BST installation

### Assembly of bst Insert Modules (IM) and Multi Insert Modules (MIM) bst Filler Blocks (FB) and Multi Filler Blocks (MFB)



Grease inner surfaces of frame with bst Lubricant



Check diameter of cables, select correct MIM and tear off your single IM if required...



...or use original MIM and put it between the cables row by row.



Anchor plates put between the module rows facilitate assembly and increase pressure tightness.



Use FB's or MFB's to fill up space for future installations.



Put in last Anchor plate before inserting the last module row. Use also Fix Anchor if required.



Grease Wedge Compression K-120 with bst Lubricant (grease also inner sides of wedges)



Push Wedge K-120 into the remaining space and...



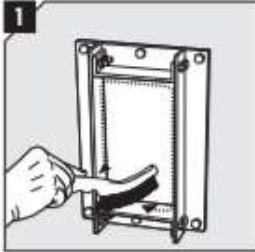
...tighten by ratchet handle or drilling machine.

You may use also the bst Power Squeezer (see B1.AC.04)

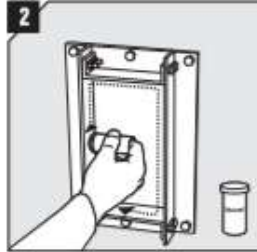


# ROXTEC installation

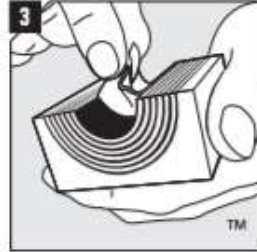
## Module installation



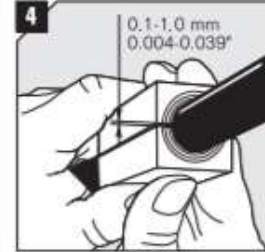
Make sure that the inside surfaces of the frame are free from dirt or dust.



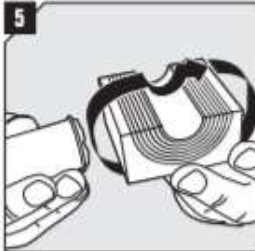
Lubricate the inside surfaces of the frame with Roxtec Lubricant, especially into the corners.



Adapt modules, which are to hold cables or pipes, by peeling off layers until you reach the gap seen in pic. 4. The halves may not differ by more than one layer.



Achieve a 0.1-1.0 mm gap between the two halves when held against the cable/pipe.



Lubricate all modules for the frame thoroughly, both the inside and the outside surfaces.



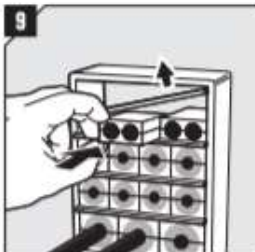
Insert the modules according to your installation plan (transit plan). It is recommended to seal cables/pipes at the bottom of the frame and put spare modules on top.



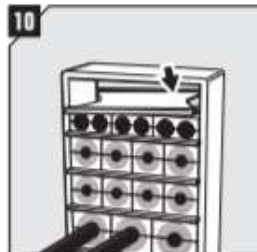
Insert a stayplate on top of every finished row of modules.



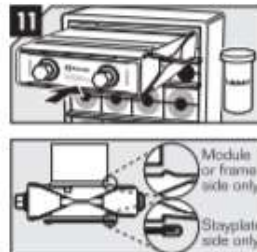
Before inserting the final row of modules, insert two stayplates.



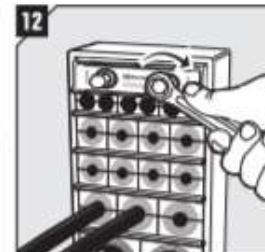
Separate the two stayplates and insert the final row of modules between the stayplates.



Drop the upper stayplate on top of the modules.



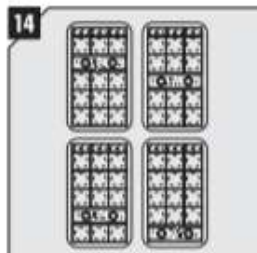
Lubricate all sides of the wedge sparsely, except front and back. Please read the markings on the wedge and turn it correctly before inserting it in the top of the frame (standard position). Face with "Stayplate this side" must always face a stayplate.



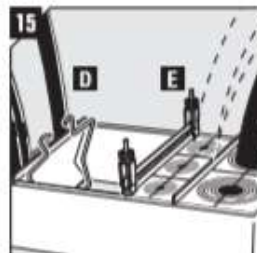
Tighten the screws until full stop, approx. 20 Nm (15 ft.lb.).



Attach the Wedge Clip to the wedge bolts to check that the wedge is properly tightened.



Optional wedge positions (anywhere within the frame).



Stayplate clips (D) and stayplate clamps (E) can be used to simplify horizontal assembly.

## MCT installation

<http://www.mctbrattberg.se/Products/Documents-and-Instructions/Installations/STG-Add-Blocks-video>

## Paste installation

### INSTALLATION INSTRUCTIONS:

General Notes: Read Safety Data Sheets (SDS) and product label for safe handling.

Step 1: All surfaces shall be clean, sound, dry, frost-free, and free of bond-breaking contaminants and loose material.

Step 2: Install MPACT Filler Blanket and Marine Wrap Strip (as required).

Step 3: Install MFS Marine Firestop Sealant.

Step 4: Smooth sealant surface with trowel, tooling knife or wet low lint rag before skin forms.

*Note: Min. 6 mm spacing needed for water and gas tightness*

