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D. Pneumatic and Fluid Modules

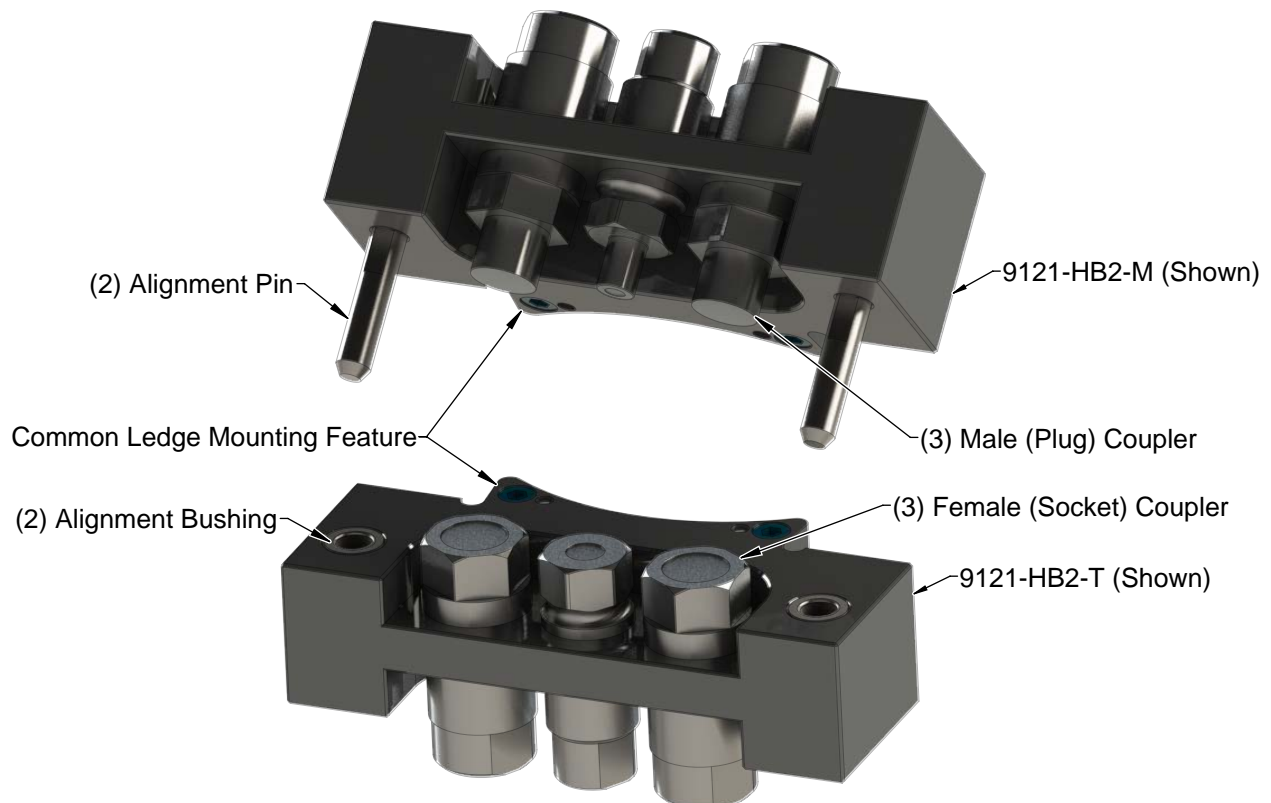
HBx Hydraulic Modules

1. Product Overview

The HBx modules are modular assemblies adapting commercial, no-drip, self-sealing fluid couplers to the ATI Tool Changers. The modules support multiple connections and are equipped with alignment pins to insure proper engagement of the couplers. The length of the couplers requires that the customer's robot drive the halves of the module together while monitoring the Tool Changer's Ready-to-Lock sensors. The customer must use flexible lines for all plumbing connections as hard pipe will not allow proper coupler alignment.

Table 1.1—Hydraulic Modules Couplers		
Modules	Connections	Tool Side Cover
HB2 modules	(2) 3/8" BSPP couplers (1) 1/4" BSPP coupler	HC2-T
HB6 modules	(2) 3/8" BSPP couplers	
HB8ZF2T1 modules	(1) 1/4" BSPP coupler	
HB9 and HB9ZF2T1 modules	(2) 1/4" BSPP couplers	HC4-T

Figure 1.1—Hydraulic Module



When a HBx-T module is not used on the Tool side, a protective cover may be supplied (per customer request) to protect the Master side hydraulic module from dust, debris, and weld spatter.

Figure 1.2— Protective Cover for Tool Side (HC2-T Shown)



2. Installation

The fluid modules are typically installed by ATI prior to shipment. The following steps outline the field installation or removal as required.



WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (e.g. electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer's safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.



CAUTION: Do not use fasteners with pre-applied adhesive more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

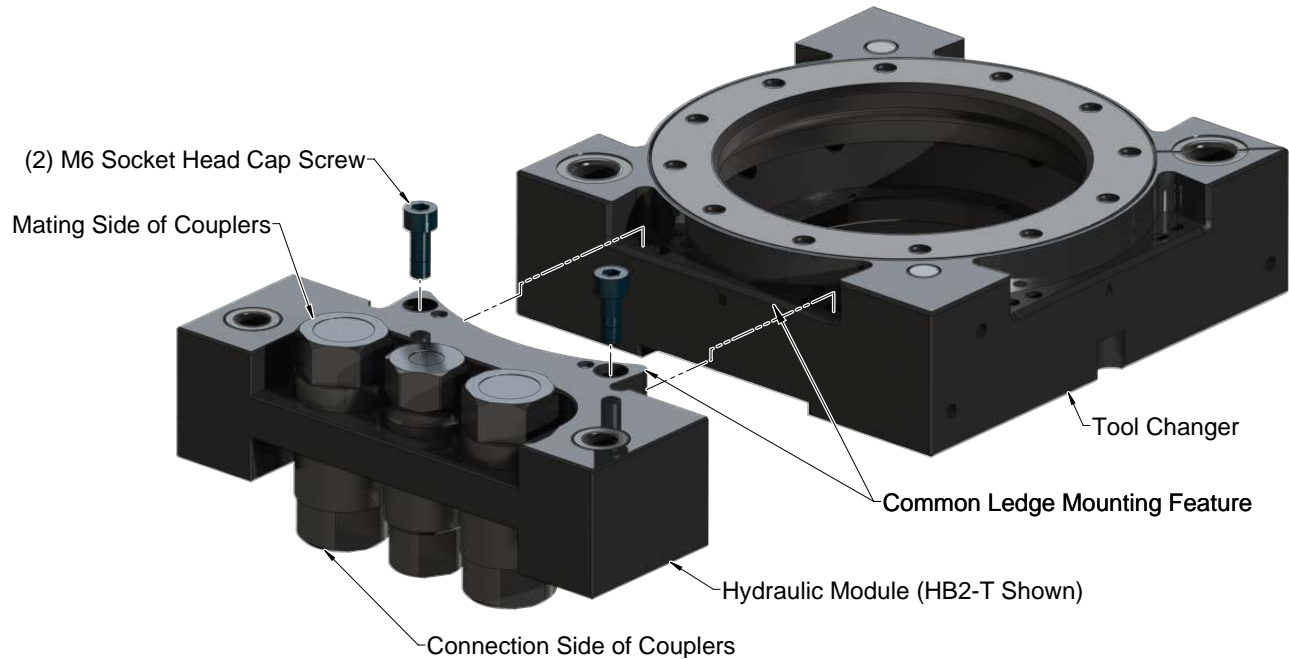
2.1 Module Installation

Tools required: 5 mm hex key

Supplies required: Loctite® 242, clean rag

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. It may be necessary to clean the mounting surface on the Tool Changer prior to installing the module in order to remove any debris that may be present.
5. Using the ledge feature, place the module into the appropriate location on the Tool Changer. Align the module with the Tool Changer using the dowels in the bottom of the ledge feature. Refer to [Figure 2.1](#).
6. If fasteners do not have pre-applied adhesive, apply Loctite 242 to the supplied M6 socket head cap screws.
7. Install the (2) M6 socket head screws securing the module to the Tool Changer and tighten to 70 in-lbs (7.9 Nm).
8. Fluid plumbing can be connected to the module after attaching the module to the Tool Changer body. Ensure that the connectors are cleaned prior to being secured as appropriate. Refer to [Figure 1.1](#).
9. After the procedure is complete, resume normal operation.

Figure 2.1—Module Installation



2.2 Module Removal

Tools required: 5 mm hex key

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Prior to removing the module use a marker pen to scribe a line or indication between the Tool Changer and module body as a reminder where the module is to be re-installed.
5. Depending upon the service or repair being done, customer connections up to the module may or may not need to be disconnected.
6. Remove the socket head cap screws and lift the module from the Tool Changer. Refer to [Figure 2.1](#).

3. Operation

The modules are designed to pass fluids from the Master to the Tool for use by the customer's tooling.

Liquids are incompressible and therefore coupling lines while pressurized must be avoided. Liquid displaced by mating coupler components creates extremely high pressure spikes and fluid velocities causing seal damage. These problems become more pronounced as the operating pressure is increased.

ATI customer drawing #9630-20-HYD shows simplified schematics for safe, reliable operation of the hydraulic couplers. For assistance in selecting components compatible with a particular process and installation, contact the application's hydraulic component distributor. In all liquid coupling applications the customer is advised to take the following steps:

- Plumb the couplers using flexible hoses which are able to absorb pressure spikes and pulses. Highly reinforced hoses and hard pipe must not be used.
- Turn off the supply pump to the circuit and discharge pressure in the lines prior to a tool change.
- Hydraulic pressure accumulators should be installed on both the Master and Tool side plumbing. This is particularly important on the tool side even with the pump turned off and master side pressure discharged.
- During routine maintenance of the Tool Changer the couplers should be inspected and re-lubricated. Water and most solvents will wash away lubricants necessary to prolong seal life.

Failure to follow these steps will result in premature seal failure, jetting of fluid from the couplers during tool changes, and significant pressure pulses in customer tooling.

4. Maintenance

Once installed, the operation of the modules is generally trouble free. Periodically the condition of the couplers should be checked. Replace any damaged or degraded couplers as necessary. Any contamination in or around the mating surfaces of the modules should be removed with a nylon brush and clean rag. During inspection, ensure that the fasteners attaching the modules to the Tool Changer are secure.

The modules may be field serviced as needed. Maintenance of the modules is simplified if repairs are limited to fitting new coupler halves to the module assemblies. Where the couplers are used to pass water and other fluids that may wash away lubricants, the couplers should be periodically re-lubricated using simple white lithium grease. Refer to [Section 4.1—Preventive Maintenance](#)



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4.1 Preventive Maintenance

A visual inspection and preventive maintenance schedule is provided in [Table 4.1](#).

Table 4.1—Preventive Maintenance Schedule Checklist

Weekly Maintenance:	
<input type="checkbox"/>	Clean mating surfaces with nylon brush and clean rag.
<input type="checkbox"/>	Inspect couplers for fluid leaks. Replace couplers as necessary. Refer to Section 5.2.1—Coupler Replacement .
<input type="checkbox"/>	Inspect alignment pins on the Master module and alignment bushings on the Tool module for damage or wear, replace as necessary. Refer to Section 5.2.2—Alignment Pin Replacement and Section 5.2.3—Alignment Bushing Replacement .
<input type="checkbox"/>	Check that module mounting bolts are secure. Refer to Section 2.1—Module Installation .

5. Troubleshooting and Service Procedures

The following section provides troubleshooting and service information to help diagnose conditions and repair the modules.



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5.1 Troubleshooting

Refer to the following table provides troubleshooting information.

Symptom	Possible Cause	Correction
Fluid leakage	Damaged/worn seals	Replace coupler halves as needed. Refer to Section 5.2.1—Coupler Replacement .
	Debris blocking coupler seal	Clean around couplers. Ensure fluid stream is free of large particulates; filter as necessary.
	Bent stem (coupler)	Replace coupler halves as needed. Refer to Section 5.2.1—Coupler Replacement . Tool Changer misalignment could cause stem and alignment pin damage. Check module attachment to Tool Changer. Check robot program and ensure parallel approach trajectory during Tool Changer coupling.
	Corrosion	Consult ATI for assistance.
Fluid spray during uncoupling	Surge/water hammer	Decrease pressure differential between supply and return lines or install pressure compensation system (e.g., accumulator or surge suppressor as close as possible to spraying port). Refer to ATI customer drawing #9630-20-HYD .
Poor flow	Flow path blockage	Inspect couplers and supply/return lines for blockage, clean/repair as necessary.
	Debris blocking coupler seal	Clean around couplers. Ensure fluid stream is free of large particulates; filter as necessary.
Modules won't couple	Bent stem (coupler) or alignment pin	Check module attachment to Tool Changer. Refer to Section 2.1—Module Installation . If alignment components are damaged, replace alignment pins or bushings. Refer to Section 5.2.2—Alignment Pin Replacement or Section 5.2.3—Alignment Bushing Replacement . If stem is bent, replace coupler halves. Refer to Section 5.2.1—Coupler Replacement . Tool Changer misalignment could cause stem and alignment pin damage. Check robot program and ensure parallel approach trajectory during Tool Changer coupling.

5.2 Service Procedures

The following service procedures provide instructions for component replacement and adjustment.

5.2.1 Coupler Replacement

During the warranty period the customer should contact ATI for repair or replacement of these components. After the warranty period the customer may purchase replacement couplers from ATI to perform their own service. The internal construction of the couplers is shown in ATI customer drawing #9630-20-COUPLER.

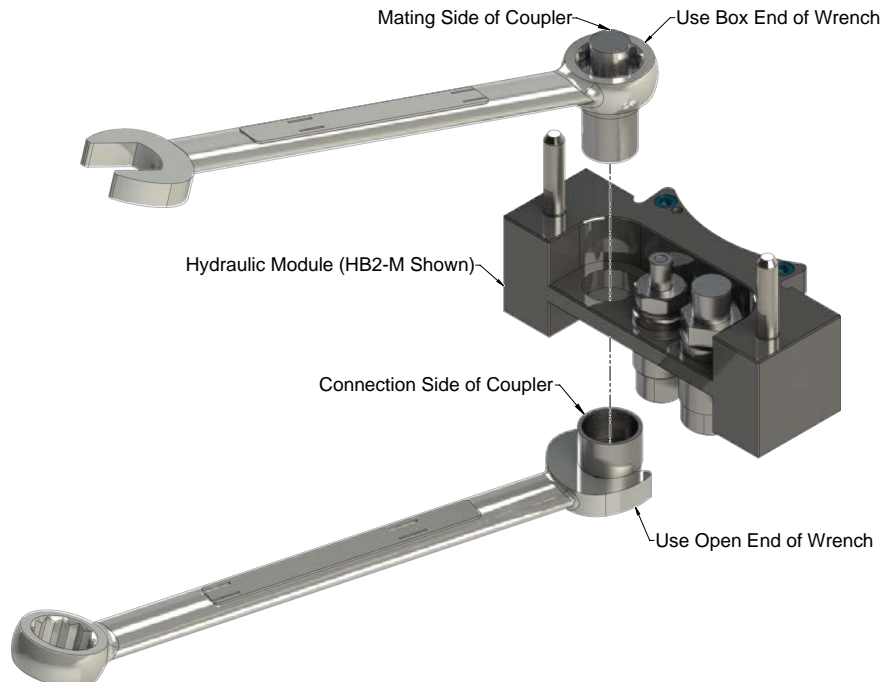
Parts required: Refer to *Section 8—Drawings*

Tools required: open end wrench, box end wrench

Supplies required: clean rag

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Purge any trapped pressure in the fluid lines and remove the hydraulic lines from the couplers.
5. Each coupler has a mating and connection side (refer to *Figure 5.1*). The mating side passes through the module's aluminum carrier and then receives the connection side which includes the female port for connection of the customer's fluid lines. Hold the mating side with a box-end wrench while using an open end wrench to remove the connection side by turning the wrench counterclockwise.
6. Discard the removed coupler.
7. Using a clean rag, wipe any debris from the coupler mounting surfaces.
8. Install the mating side of the new coupler by passing it through the module's aluminum carrier and then install the connection side of the new coupler. Hold the mating side with a box end wrench while using an open end wrench to install the connection side by turning the wrench clockwise. Tighten to appropriate torque (refer to *Section 8—Drawings*).
9. After the procedure is complete, resume normal operation.

Figure 5.1—Coupler Replacement



5.2.2 Alignment Pin Replacement

The Master side HBx modules include hardened alignment pins. These pins orient the male and female coupler halves correctly during tool changes to prevent damage. Following extended periods of use the pins may wear and need replacement.

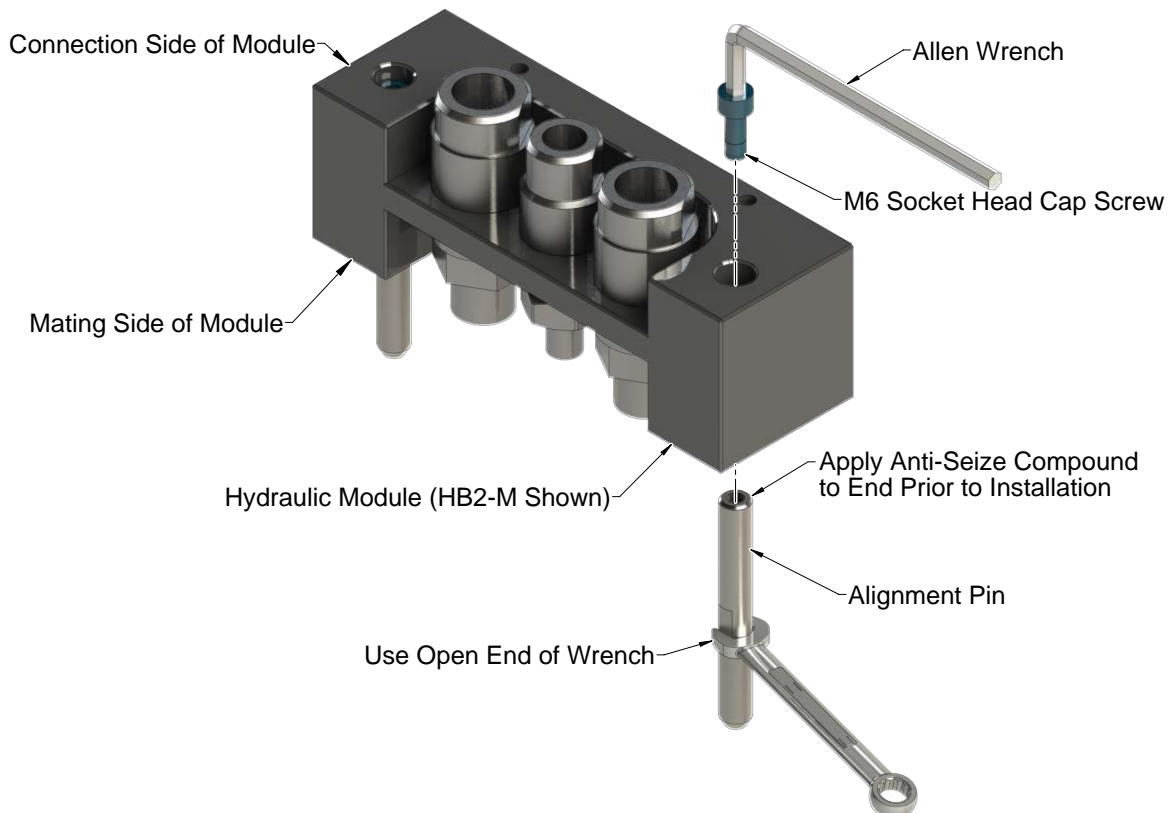
Parts required: Refer to [Section 8—Drawings](#)

Tools required: 8 mm open end wrench, box end wrench or adjustable wrench, 5 mm Allen Wrench (hex key)

Supplies required: anti-seize compound, Loctite 242, clean rag

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Hold the flats on the alignment pin using a suitable open end or adjustable wrench. Refer to [Figure 5.2](#).
5. Use a 5 mm Allen Wrench to remove the M6 socket head cap screw securing the alignment pin.
6. Pull the alignment pin out of the carrier plate and discard.
7. Using a clean rag, wipe any debris from the alignment pin mounting surface.
8. Apply a thin film of anti-seize compound to the end of the new alignment pin that goes in the carrier.
9. Install the alignment pin.
10. Apply Loctite 242 or similar to the M6 socket head cap screw prior to installing. Tighten to appropriate torque (refer to [Section 8—Drawings](#)) while holding the alignment pin with wrench.
11. After the procedure is complete, resume normal operation.

Figure 5.2—Alignment Pin Replacement



5.2.3 Alignment Bushing Replacement

The Tool side HBx modules include hardened bushings to receive the Master side alignment pins. These bushings orient the male and female coupler halves correctly during tool changes to prevent damage. Following extended periods of use the bushings may wear and need replacement.

Parts required: Refer to [Section 8—Drawings](#)

Tools required: 5 mm Allen Wrench® (hex key)

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the Tool module from the Tool Changer.
5. Using a suitably sized drift and an arbor press, press the old bushings out of the carrier.
6. Using a suitably sized drift and an arbor press, press the new bushings into of the carrier. Note that the new bushings should be installed by pressing the chamfered end in first, stopping when the bushing is flush with the top surface of the carrier.
7. After the procedure is complete, resume normal operation.

6. Recommended Spare Parts

Refer to [Section 8—Drawings](#).

7. Specifications

Table 7.1—HB2 Module Specifications		
Connection Size	3/8" BSPP	1/4" BSPP
Number of Ports	2	1
Cv	1.23	0.46
Pressure Rating	Maximum pressure of 2300 psi (158 bar), Self-sealing on Master and Tool	
Static Separation Force (created by internal springs)	75 lb (330 N) (force/3 couplers)	
Hydraulic Separation Force (per pressurized line)	3/8" BSPP force (lbf) = 0.24 x PSI; (N) = 15.484 x bar 1/4" BSPP force (lbf) = 0.13 x PSI; (N) = 8.387 x bar	
Weight	Master - 3.24 lbs (1.47 kg) / Tool - 2.87 lbs (1.30 kg)	

Table 7.2—HB6 Module Specifications	
Connection Size	3/8" BSPP
Number of Ports	2
Cv	1.23
Pressure Rating	Maximum pressure of 7200 psi (496 bar), Self-sealing on Master and Tool
Static Separation Force (created by internal springs)	56 lb (250 N) (force/2 couplers)
Hydraulic Separation Force (per pressurized line)	3/8" BSPP force (lbf) = 0.24 x PSI; (N) = 15.484 x bar
Weight	Master - 3.24 lbs (1.47 kg) / Tool - 2.87 lbs (1.30 kg)

Table 7.3—HB8ZF2T1 Module Specifications	
Connection Size	1/4" BSPP
Number of Ports	1
Cv	0.46
Pressure Rating	Maximum pressure of 7200 psi (496 bar), Self-sealing on Master and Tool
Static Separation Force (created by internal springs)	18 lb (80 N) (force/1 coupler)
Hydraulic Separation Force (per pressurized line)	1/4" BSPP force (lbf) = 0.13 x PSI; (N) = 8.387 x bar
Weight	Master - 2.1 lbs (0.95 kg) / Tool - 1.8 lbs (0.82 kg)

Table 7.4—HB9 Module Specifications	
Connection Size	1/2" BSPP
Number of Ports	2
Cv	2.26
Pressure Rating	Maximum pressure of 7200 psi (496 bar), Self-sealing on Master and Tool
Static Separation Force (created by internal springs)	74 lb (330 N) (force/2 couplers)
Hydraulic Separation Force (per pressurized line)	1/2" BSPP force (lbf) = 0.33 x PSI; (N) = 21.4 x bar
Weight	Master - 2.83 lbs (1.28 kg) / Tool - 2.53 lbs (1.15 kg)

Table 7.5—HB9ZF2T1 Module Specifications	
Connection Size	1/2" BSPP
Number of Ports	2
Cv	2.26
Pressure Rating	Maximum pressure of 7200 psi (496 bar), Self-sealing on Master and Tool
Static Separation Force (created by internal springs)	74 lb (330 N) (force/2 couplers)
Hydraulic Separation Force (per pressurized line)	1/2" BSPP force (lbf) = 0.33 x PSI; (N) = 21.4 x bar
Weight	Master - 3.24 lbs (1.47 kg) / Tool - 2.87 lbs (1.3 kg)

8. Drawings

Drawings are available on the [ATI website](#) or by contacting an ATI representative.