TECH TALK Nº. 40

FACTORS IN CHOOSING A HYDRANT PIT

BY

CONTENTS:

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CONSIDERATIONS IN CHOOSING A HYDRANT PIT

1. Introduction

'Hydrant system' is the term used for an airport system for refuelling aircraft where underground pipes take the fuel to the aircraft parking positions.

Several connection points are provided underground beneath the aircraft to allow for various aircraft sizes and models. Each point contains a refuelling valve which is in a sealed container with a removable lid (hydrant pit).

The pit is designed to prevent any spilt fuel leaking into the ground: to prevent any rising ground-water leaking into the pit: to prevent rainwater leaking from the surface into the pit: and to withstand the weight of the heaviest aircraft wheel should it roll over the pit.

The valves are high-precision machinery in a hard working environment and require regular maintenance. The hydrant pit must allow access for adjustment and also complete removal.

2. Size in Diameter

The two common sizes in use around the World for 4 inch API valves are 18 inch (460mm) and 24 inch (600mm) body diameters.

18 inch is cheaper and lighter but the API valve takes up much of the room in the pit and it is often necessary to make up special tools to access the valve components.

24 inch is more expensive and heavier, and is supplied with a two-piece lid to limit the lifting weight. (Only the inner is removed for refuelling). Access for adjustment and maintenance is excellent and there is plenty of room for fitment of any other future accessories.

3. Size in Depth

In order for API couplers to attach to the API adaptor, the adaptor face should be 100mm below the rim of the pit.

Higher than this and the lid will hit the valve face.

Lower, and the coupler feed pipe will not allow the coupler to drop far enough to latch.

The hydrant pit depth need not then be any deeper than necessary to fit the current longest pit valve assembly plus some allowance for future ground movement. Having an overall pit depth greater than necessary just impedes maintenance and cleaning activities.

4. Body Material

Typical choice is between steel, fibreglass or plastic. Each has different benefits/limitations which can be summarised as follows:-

Steel

- Moderate cost.
- Easy to tool for local manufacture.
- Only basic manufacturing techniques required.
- Very heavy — costlier transport, difficult to install, requires power lift equipment.
- Susceptible to corrosion, finish coating quality is critical.
- Requires separate seal onto inlet pipe to provide seal and flexibility.

Plastic

- Cheapest of all.
- Requires specialised tooling and manufacturing skills.
- Lightest of all — very easy to transport and install.
- No corrosion or chemical attack issues.
- Integral seal onto inlet pipe to provide seal and flexibility with one piece construction.

Fibreglass

- Moderate cost.
- Specialist manufacturing skills required.
- Weight mid-way between plastic and steel.
- Susceptible to damage during transport and handling.
- No corrosion or chemical attack issues.
- Requires separate seal onto inlet pipe to provide seal and flexibility.

Summary

Plastic body is by far the superior solution.

5. Cathodic Protection

All hydrant pipework is fitted with cathodic protection. If a steel hydrant pit is chosen, it is essential the pit be given a thick coating of epoxy or similar to electrically isolate it from earth otherwise the cathodic protection system can be "overloaded" with consequent deterioration of piping protection.

Plastic and fibreglass do not require this additional process.

6. Sealing, Body-to-Pipe

Riser pipe enters pit through a hole in the bottom. This annulus requires a seal to prevent spilled fuel from leaking into the ground and to prevent rising ground-water from flooding the pit.

One other function is to provide flexibility, as ground movement over the years can produce relative movement between the surface concrete and underlayer. A movement of 50mm sideways between pipe and pit has been known.

The standard modern solution is to employ a bellows between the pit body and the riser pipe flange to both seal and flex.

A separate rubber bellows clamped at both ends is used on steel and fibreglass pits.

A superior method can be used on plastic pits as the bellows is moulded one-piece with the body to avoid faulty clamping or rubber perishing. The riser pipe flange requires special machining in this case, available as part of the assembly from Liquip.

7. Inlet Pipe Size

In the early 1960's when systems were still being developed 6 inch (150mm) flanges and valves were specified.

Modern systems now use 4 inch (100mm) riser pipes, 4 inch ANSI flange stud patterns and 4 x 4 hydrant pit API valves such as the Carter 60554.

8. Pit Drainage

The hydrant pit may at times collect spilt fuel or flooding rainwater.

Systems have in the past been devised where each pit has a small drain in the bottom, piped off and manifolded with other pits to an underground collection tank which collects all drainings. In our experience, operators have found it to be cheaper and safer to build a suck-out vehicle which does a regular dry-out run around the airport to clean out the pits as part of the normal maintenance procedure.

The self-draining systems were subject to too many blockages, pipe leaks and over-filling of the collection tank if sophisticated alarms were not installed.

9. Ability to Lift Pit After Re-Surfacing

It is not uncommon for airport surfaces to be lifted during construction work, for various reasons.

All Liquip hydrant pit bodies allow for the rim only to be dug around, then an extension piece can be inserted to adjust the height of the rim to the new concrete level. (A spacer flange must also be inserted on the riser pipe to lift up the pit valve equally).

10. Attachment of Lid to Body

Pit lids are run over by aircraft and vehicles: and can receive substantial jet blast from jet engines under power.

A hold-down system is essential and many operators also fit a safety chain. Typical holding systems include:

- Hinged lid.
- Bayonet twist-to-lock.
- Spring-latch.

Hinged lids provide excellent retention but have the problem of sitting in one position once opened. Hydrant carts have to position themselves under the wing fuelling point then run the ground hose to an accessible pit valve. If the hinged lid happens to be in the way, fitting the coupler into the pit can be a real problem.

Also, some operators will not use hinged lids on safety grounds. Lids have been thrown over to close while operators have still had their hands in the pit.

Bayonet twist-to-lock fasteners are very cheap and simple. Draw-backs are that it is difficult to tell if the operator has twisted the lid to the lock position (or a vehicle's spinning wheels have unlocked it). If the lid has just been dropped in, a jet blast venturi effect can lift a 25kg lid and propel it over 50 metres away. Proven on Sydney airport.

Spring-latch fasteners are used in the Liquip plastic lid. These are like door latches and are more expensive than bayonet and hinged systems.

Advantages are that the operator does not have to twist the lid to lock: all that is required is to step on the lid to snap it closed: it is a positive catch: and the lid can be removed for easy coupler access.

11. Water Ingress

Water is not welcome in a hydrant pit primarily because of the quality requirements for Jet fuel.

Ideally the hydrant pit lid would provide a waterproof seal, but the conditions on an airport, with frequent opening and closing under dusty, hot, cold, dry, wet, ice, snow, hydrocarbon-laden, U-V radiation conditions, waterproof is not a realistic expectation.

All designs incorporate seals or water-shed features to minimise water entry due to rain: and installation is always recommended to be at a raised area, typically 30mm above surface to provide drainage. General run-off gradients on the airport should prevent the flooding over of any hydrant pit as none will provide true water-tightness in operational circumstances.

As an aside, where a hydrant pit is installed new and the area is clean, a pit-lid can provide a waterproof joint and may continue to do so for some time. This can lead to a situation where the lid cannot be opened due to an internal vacuum e.g. due to overnight cooling.

The Liquip composite (plastic) hydrant pit has excellent sealing and it is equipped with a small vacuum breaker to prevent this suction force.

The Liquip steel hydrant pit does not use a seal as they are damaged almost immediately in a twist-and-turn operation of the bayonet fixing. Instead it uses a water-shed ring around it's circumference with a mushroom rain-shedder on the lid.

12. Weight of Lid

Because the lid is, by definition, mounted at ground level, the operation of lifting it has very poor ergonomics so the weight of the lid must be minimised to compensate.

This light weight requirement must be balanced against the requirement to take a proof load equivalent to 900 psi (6.3 MPa) and a maximum intermittent working load of 300 psi (2.1 MPa).

The Liquip 18 inch aluminium lid weights 25kg as used on the HP18 style steel-bodied hydrant pit. This is at the high-limit of acceptable weight.

The high-tech composite lid as used on the plastic-bodied HPC200 series weights only 13kg, and is acceptable for regulated weight allowed for both male and female operators.

Various lifting aids have been devised by operators around the World but none have been readily accepted. Light weight is still the best solution.

13. Installation

As mentioned in item 10 above, the hydrant pit must be installed in a position and manner to ensure surface water run-off.

The installation is designed from the rim downwards, to ensure good coupling from the hydrant ground coupler to the API adaptor. Given the hydrant pit valve has already been selected, this then determines the installed height of the riser pipe flange. (Note: some companies deliberately set the flange lower, using a spool-piece to fill the gap, in case of some future requirement which may need fitting or to allow for ground movement).

The pit body is lowered over the riser pipe flange. A spider arrangement is bolted to the riser pipe flange with adjusters to enable the pit to be centralised and levelled in all axes and bolted securely ready for concrete pouring.

Polystyrene or similar blocks are cut to shape to block off the annulus between pipe and pit entry until the concrete is set.

Earth straps are run from the riser pipe flange through to the hydrant pit rim via all intervening metallic parts to enable continuity testing.

The above is fully detailed in the appropriate installation manuals.

It must be highlighted that the conventional steel pit body weights 125kg (24 inch model) against only 30kg for the plastic model.

The ease of handling of the plastic unit, and the fact the bellows and seal is formed as part of the body, has allowed three times more pits per day to be installed than with the steel unit.

USER REFERENCE LIST

HYDRANT PITS & LIDS

LOCATIONS:

- Sydney
- Melbourne
- Perth
- Darwin
- Townsville
- Brisbane
- Coolangatta
- Cairns
- Proserpine
- Hamilton Island
- Alice Springs
- Various RAAF Bases
- Port Moresby PNG
- Cook Islands
- Fiji
- Tonga
- Vanuatu
- Kuwait
- Western Samoa
- Auckland
- Wellington
- Christchurch

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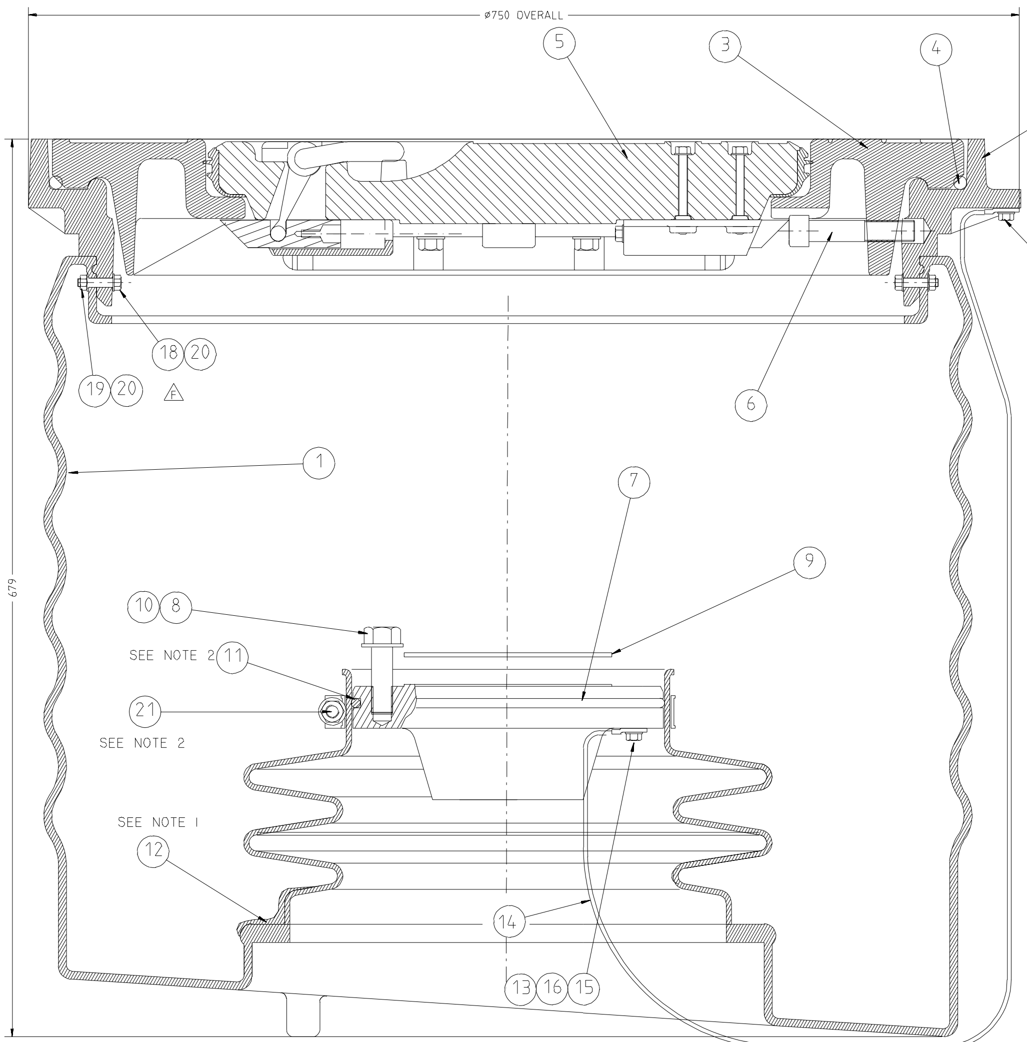
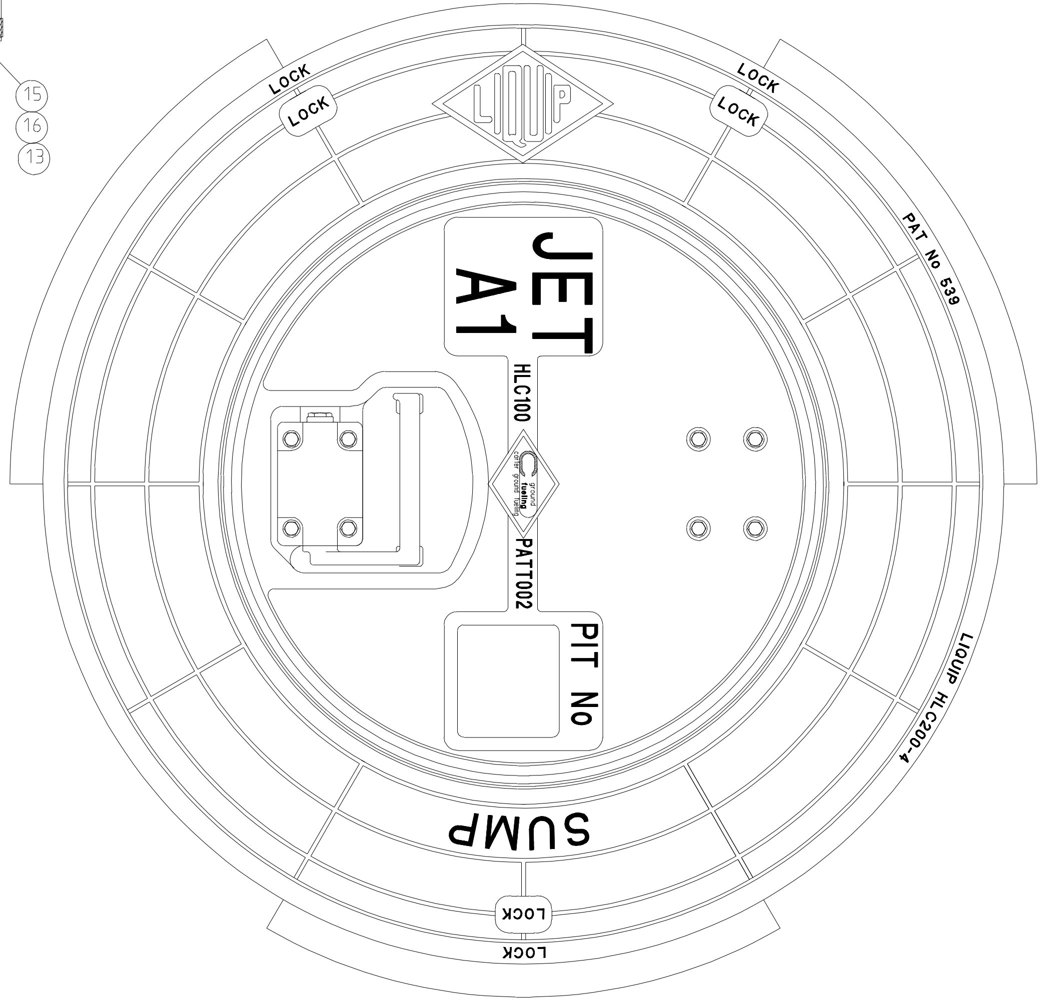
INFORMATION





ITEM	PART NO	DESCRIPTION	HPC200 QTY/ASS	HPA200 QTY/ASS	HPC201 QTY/ASS	HPA201 QTY/ASS	MATERIAL	GRADE	WEIGHT (kg)	DRAWING No
1	HLC200-2	BODY HYDRANT PIT C/W BELLOWS & RIM	1	1			POLYETHYLENE	MARLEX	15	H75998
	HLC201-2	BODY HYDRANT PIT C/W RIM ONLY			1	1	POLYETHYLENE	MARLEX	12	H75998
2	HLC200-4	RIM 24" C/W EPOXY COATING	1	1	1	1	CAST ALUM	T6	16	H76198
3	HLC200-3	OUTER COVER 24" HYDRANT PIT	1	1	1	1	CAST ALUM	T6	23	H76098
4	4625	SEAL OUTER COVER 24" HYDRANT PIT	1	1	1	1	TBA	TBA	0.01	
5	HLC100	COVER 18" COMPOSITE FIBER SINGLE LATCH	1		1		COMPOSITE	-	12	H75098
	HLA100	COVER 18" ALUMINIUM SINGLE LATCH		1		1	CAST ALUM	AP601	27	
6	6465	CAPSCREW M16 X 80 LG	3	3	3	3	STAINLESS STEEL	304	1	
7	HLC100-8	FLANGE ADAPTOR 100NB RF	1	1	1	1	STEEL	A106	11	H76398
8	4900	BOLT 5/8"UNC X 3" LG	8	8	8	8	BLACK STEEL	B7	0.01	
9	4235	GASKET 100NB 150LB SEAL FACE	1	1	1	1	KLINGERITE	-	0.01	
10	0846	NUT 5/8" UNC	8	8	8	8	BLACK STEEL	2H	0.3	
11	0198	O RING	1	1	1	1	BUNA	N	0.01	
12	5795	COATING EPOXY AVIATION RESISTANT	AS REQ	AS REQ	AS REQ	AS REQ	EPOXY	-	-	
13	1372	EARTHING LUG	2	2	2	2	COPPER	-	0.001	
14	LW400-6	EARTHING WIRE C/W SWAGED LUGS BOTH ENDS	1	1	1	1	STAINLESS STEEL	304	0.1	TBA
15	3240	BOLT 1/4" BSW 3/4" LG	2	2	2	2	STAINLESS STEEL	304	0.01	

THESE MAKE KIT HLC200-12 FLANGE KIT (items HLA100–9)

SEE NOTE I (item 10)

THESE MAKE KIT HLC200-II BONDING KIT (items 11–14)

NOTE;
I. ITEMS I2 & I7 TO BE APPLIED TO THE AREA SHOWN AS PER INSTRUCTIONS ON LIQUIP DRAWING H75998.
2. TO CORRECTLY FIT THE FLANGE TO THE BELLOWS ENSURE THE BELLOWS IS CLEAN. APPLY AVIATION CEMENT (LOCTITE) TO THE FLANGE AROUND THE O RING. FIT THE O RING TO THE FLANGE AND SLIDE THE PIT BODY OVER THE FLANGE. FIT THE CLAMP AND TIGHTEN EVENLY TO 44 NM

TESTING REQUIREMENTS: CLOSE VISUAL INSPECTION		PACKAGING REQUIREMENTS: STRAP TO PALLET & SHRINK WRAP	
THIS DRAWING AND DESIGN IS THE PROPERTY OF LIQUIP SALES PTY LTD. IT MUST NOT BE COPIED OR REPRODUCED IN ANY WAY WHATSOEVER AND/OR PASSED ON TO ANY THIRD PARTY WITHOUT WRITTEN AUTHORITY		DRAWN BY	GH
STD TOLERANCES & PRACTICES	HEAT TREATMENT: NA	CHECKED	
DIMENSIONS / CASTING / MACH	MATERIAL: NA	APPROVED	
WHOLE NUMBER / ±1mm / ±0.5mm	PROTECTIVE TREATMENT: NA	ASSY DRWG	NA
DECIMAL 1 PLACE / NOMINAL / ±0.1mm		PATTERN No	NA
DECIMAL 2&3 PLACES / NOMINAL / ±0.04mm			