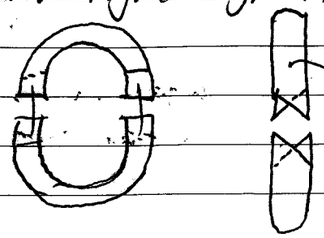
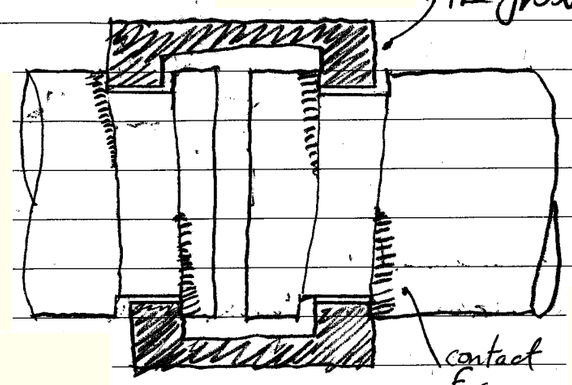
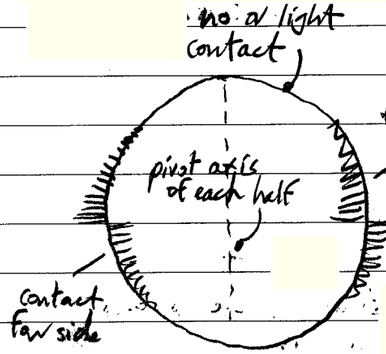
Victaulics – cont'd

see how rigid style 07 is tightened.



each half twists as it is tightened and moves apart to contact one side of the groove





END VIEW

all loads are transmitted via contact force coupling half ↔ groove

then { contact force between halves of coupling
some shear in bolt }

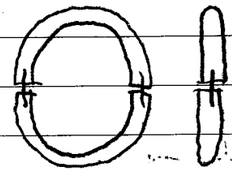
etc

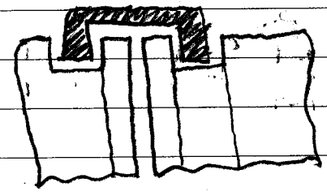
so load path is complex!

no mention in catalogue of cyclic duty, but SIF must be high.

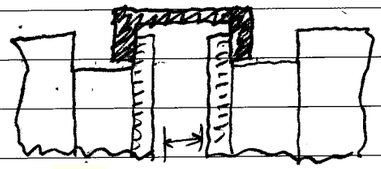
Victaulics cont'd

see how Flexible style 770 & 77 is tightened, and think about rotation.





unpressurised
no firm contact



pressurised
pipe moves onto
firm contact

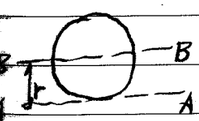
all loads are transmitted
via contact force thro through coupling & not via bolts.
under action of bending moment + pressure, the coupling will
be rigid if pressure dominates
be flexible if moment dominates } derive formula

pressure – even distribution

r = contact radius ≒ limit of pressure

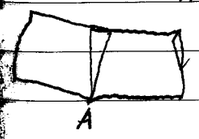
F_L = line load (N/mm) $= \pi r^2 P \div 2\pi r = Pr/2$

moment – uneven distribution – with pivot about pipe radius
which is approx' equal to r



for circle about B-B $I_{BB} = \pi r^3 t$ t = imaginary thickness

I_{BB} = area $\times k^2 = 2\pi r t (r^2/2)$



apply parallel axis rule to shift pivot axis to A-A by r

I_{AA} = area $\times (k^2 + r^2) = 2\pi r t (r^2/2 + r^2)$

$= 3\pi r^3 t$ (mm⁴)

now convert to line section modulus $I_{AA,L} = 3\pi r^3$ (mm³)

line load (N/mm) due to moment M

$F_L = M \times r \div I = M/3\pi r^2$

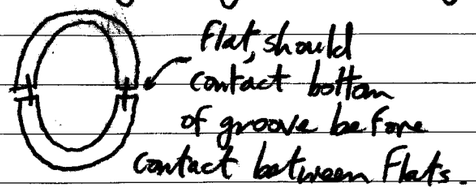
revised Mar-09. "1.5" was "0.75"

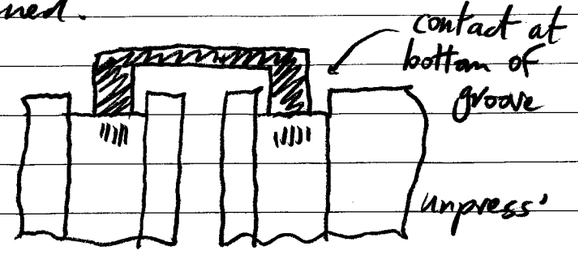
for rotation to commence at a coupling that is fully extended
due to pressure, F_L due to M must exceed F_L due to P

$$M > 1.5\pi r^3 P$$ "yield moment"

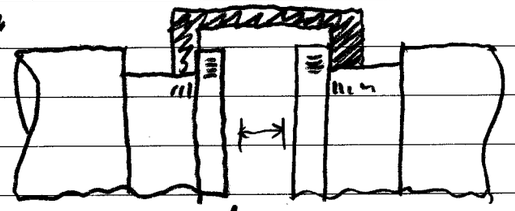
e.g. if $P = 0.5$ N/mm² $r = 200$mm $M > 18.8 \times 10^6$ Nmm $= 18800$ Nm
which is bending stress 25 N/mm² if $t = 6.0$.

see how rigid style 89 is tightened.





when "sufficiently pressurised" coupling will slip to make additional contact at side of grooves.
This "pressure at slip" is not required to be calculated.



pressurised, pipe moves out

all loads transmitted through coupling and not bolts, so for cyclic loads should perform better than style-07.

Allowable moments for style 07 & 89,
These are given in catalogue as "permissable end load" which is "...total, from all internal and external loads"
like a flange (pressure equivalent formula) P and M are linked $P_{EQUIV} = \frac{2M}{\pi r^3}$ $P_{TOTAL} = P_{DESIGN} + P_{EQ}$

end load $= P_{TOTAL} \times AREA = \pi r^2 \left(P_{DESIGN} + \frac{2M}{\pi r^3} \right)$

unchecked !

end load $= P_{DESIGN} \times \pi r^2 + \frac{2M}{r}$ compare with catalogue.

e.g. 07-12"NB $r = 162mm$ rated end load 22695ON MAX' PRESS' $2.75 N/mm^2$
say 10barg $= 1.0 N/mm^2$ moment $M = 15 kNm = 15 \times 10^6 Nmm$
EQ' END LOAD $= 1.0 \times \pi r^2 + 2M/r = 82.4kN + 185.2kN = 268kN$
SINCE $268kN > 227kN$ not acceptable. FAIL.
OR USE
$P_{TOTAL} = 1.0 + \frac{2M}{\pi r^3} = 3.2 N/mm^2$ MAX' RATED (catalogue) $= 2.75 N/mm^2$ ∴ FAIL