Chapter 22
TAPE DRIVES

Chapter written by Brian Hailstone and Jim Egginton and lately edited by Dave Bazley . . .

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22.1 Tape drive summary

Table 22–1: Tape drives, Cartridge

Device	Bit density	Format	Tape speed	Connection	Peak transfer	Cartridge capacity
TZ30	6667	Serpentine	75	SCSI	62.5KBs	95MB
TK50	6667	Serpentine	75	LESI	62.5KBs	95MB
TK70	10000	Serpentine	100	LESI	125KBs	296MB
TF/TZ85	42500	Serpentine	100	DSSI/SCSI	800KBs	2.6GB
TF/TZ86	42500	Serpentine	100	DSSI/SCSI	800KBs	6.0GB
TZ87	62500	Serpentine	110	SCSI	1.25MBs	10.0GB[1]
TKZ10	16000	QIC	120	SCSI	240KBs	525MB
TLZ04	61000	4mm Helical	0.35	SCSI	183KBs	1.2GB
TLZ06	61000	4mm Helical	0.35	SCSI	183KBs	2.0GB[1]
TKZ08	110000	8mm Helical	0.35	SCSI	180KBs	2.2GB
TKZ09		8mm Helical	0.35	SCSI	500KBs	5.0GB
TKZ60	38000	IBM 3480	39	SCSI	1.5MBs	200MB
TA90/91	38000	IBM 3480	78.7	STI	2.6MBs	200MB[1]

[1]Capacity can be doubled (and more?) if data compaction is used

Table 22-2: Tape drives, Magazine

Device	Drive used	Connection	Number of cartridges	Unattended capacity
SA100/TA857	TZ85	STI	7	18GB
SA106/TA867	TZ86	STI	7	42GB
SF100/TF857	TF85	DSSI	7	18GB
SF106/TF867	TF86	DSSI	7	42GB
SZ100/TZ857	TZ85	SCSI	7	18GB
SZ106/TZ867	TZ86	SCSI	7	42GB
SZ107/TZ977	TZ87	SCSI	7	70GB[1]
TA90/91	TU90	STI	6	1.2GB[1]

[1]Capacity can be doubled (and more) if data compaction is used

Table 22-3: Tape drives, 9 track, 10.5 inch reel

Device	Bit density	Format	Tape speed	Connection	Peak transfer
TE16	800, 1600	NRZI, PE	45	Massbus	72KBs
TU77	800, 1600	NRZI, PE	125	Massbus	200KBs
TU78/79	1600, 6520	PE, GCR	125	Massbus	781KBs
TA78/79	1600, 6520	PE, GCR	125	STI	781KBs
TS11	1600	PE	45	Unibus	72KBs
TU80	1600	PE	25/100	Unibus	160KBs
TA81	1600, 6250	PE, GCR	25/75	STI	468KBs
TU81/81E	1600, 6250	PE, GCR	25/75	LESI	468KBs
TSU05	1600	PE	25/100	Unibus	160KBs
TSV05	1600	PE	25/100	QBUS	160KBs
TSZ05	1600	PE	25/100	SCSI	160KBs
TSZ07	1600, 6250	PE, GCR	100	SCSI	625KBs

22.2 TE10/TE16

Table 22–4: TE16/TE10 common parts list

Part no.	Description
70-09835†	capstan motor assy
12-09786†	capstan motor
74-07957	capstan wheel
74-07958	capstan clamp
12-11720	BOT/EOT sensor
70-09644-01	reel motor assy (bottom)
70-09644-02	reel motor assy (top)
12-09677	reel motor
12-10027	brake for reel motors
70-13585-01	R/W head assy
70-16687‡	vacuum assembly
12-11581	belt for vacuum assy
12-13119	reel hub assy
29-11760	hub repair kit
12-10477	vacuum switch
12-09403-02	fan
70-16659	write-lock assembly
54-12242	power supply PCB assy
H607	tape motion PCB assy

†Use either number to get capstan motor
‡You must check pulley and motor positions are set for 50Hz

22.2.1 Vacuum assembly replacement

The vacuum assembly for TE10 and TE16 (and later TU16's) often arrive from logistics configured for 60Hz. Before fitting the new assembly to the drive you must check that it is set for 50Hz.

The difference between 50Hz and 60Hz is that for 50Hz the belt must be on the larger diameter pulley on the vacuum motor, 60Hz uses the smaller diameter pulley. It is also necessary to move the mounting position of the motor so that the belt fits properly.

The motor position can be changed by removing the 4 screws that hold the motor to the mounting plate and repositioning to a second set of mounting plate holes. For 50Hz the motor must be mounted so that it is uses the holes nearest to the vacuum pump.

The position of the pulley on the motor shaft should be adjusted so that the belt runs correctly. A ruler or some straight edge laid against the large pulley is the easiest way to get the two pulleys in line.

Finally adjust the belt tension by slackening off the 6 nuts that hold the motor mounting plate to the main assembly and then adjusting the belt tension screw. Retighten the 6 nuts.

22.3 TU77/Tx78/Tx79

22.3.1 Parts Information

Table 22–5: Part no's for TU77/Tx78/Tx79 belts and pulleys

Description	Pertec no	DEC no.
Newer TU77's and all Tx78's and Tx79's.		
Blower belt 50Hz 0-2000ft	108479-04	29-23989
Motor hub 50Hz	107042-02	29-23284
Motor pulley 50Hz 0-2000ft	108478-09	29-24002
Compressor belt 0-2000ft	108479-08	29-23996
Compressor pulley 0-2000ft	102635-01	29-24009
Compressor hub	107041-01	+L-10657
Old TU77's (serial no's up to SP03315)		
Blower belt 50Hz low altitude	108479-05	29-23990
Motor hub 50Hz	107042-02	29-23284
Motor pulley 50Hz low altitude	108478-03	29-23301
Compressor belt	108479-02	29-23294
Compressor pulley	102635-02	
Compressor hub	107041-01	+L-10657
Miscellaneous parts required for pulleys		
Grub screw	603-1404	+L-10658
Woodruff key	609-6208	+L-10659
Pulley screws, high strength	602-0607	+L-10660
Pulley screws, standard	602-0608	+L-10661

Table 22–6: TU77/Tx78/Tx79 odds and ends part numbers

Part no.	Description
29-23965	Capstan wheel
29-25045	Pucker pocket rubber pad
29-22568	TU77 terminator packs for PCB's
90-07775-04	Hardened ball studs for front doors
29-26968-01	Tx79 control panel
29-23361	Air ports rubber cap
29-23655	Hose kit

22.3.1.1 TU77 part differences

Some swap kits for TU77, TU78/79 and TA78/79 are combined into one kit. This has led to TU77 parts being fitted into Tx78's and visa-versa. If you use the kit listings to find the part number from the description of the part you might select the wrong part. Please use the appropriate pocket service guide or IPB to ensure that the correct part is selected.

Here is a list (not necessarily comprehensive) of the parts that are different, but with the same description and look physically similar. The vendor part number actually on the part is a good check if there is any possibility of the part having been put into the wrong packaging. In the table below "Tx78" means "TU78, TU79, TA78 and TA79 part"

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Description	TU77 part number		Tx78 part number	
	Digital	Vendor	Digital	Vendor
Head, R/W	29-23233	530-6369	29-23767	530-6099
Capstan motor assy	29-23234	107016-01	29-23768	107016-02
Control M2 PCBA	29-23774	106876-02	29-23764	106876-12
Capstan/regulator PCBA	29-23230	104758-01	29-23765	104758-02

22.3.1.2 Control M2 jumpers

22.3.1.2.1 TU77

- Rev K and below - 1, 2, 3, 9, 10, 13 and 17 all in, others out.
- Rev L to T - 1, 2, 3, 9, 10, 13, 17, 19 and 21 all in.
- Rev U - 1, 2, 3, 9, 10, 12, 13, 17, 19, 21 and 23 all in.
- Rev V or above - 1, 2, 3, 9, 10, 13, 17, 19, 21 and 23 thru 31 all in.

22.3.1.2.2 Tx78/Tx79

For jumpers W5 - W10 see below.

- Rev M and below - 1, 2, 3, 13, 14 and 15 all in, others out.
- Rev N to X - 1, 2, 3, 13, 14, 15 and 20 all in.
- Rev Y to AB - 1, 2, 3, 12, 13, 14, 15, 20, and 23 all in.
- Rev AC or above - 1, 2, 3, 12, 13, 14, 15, 20 and 23 thru 31 all in.

If W2 is out the drive comes online after loading.

W5 - W10 are dependant on the capstan motor vendor. If the control M2 module is rev AK or above then use the "YASKAWA" setting for all types of capstan motor.

Motor vendor	W5	W6	W7	W8	W9	W10
YASKAWA	IN	OUT	OUT	OUT	IN	IN
PACIFIC SCIENTIFIC	OUT	IN	IN	IN	OUT	OUT
HONEYWELL	OUT	IN	IN	IN	OUT	OUT

22.3.1.3 Terminating resistor packs missing.

The resistor packs on the TU77 read module (29-23227) and write module (29-23226) may be missing from the modules in the swap kit. Please check that the resistor packs are installed before putting the module in the drive. You can use the packs from the old module if resistor packs not available. Part number for resistor packs is 29-22568.

Read module   Resistor packs in locations U22 and U25
Write module   Resistor packs in locations U14 and U12

22.3.1.4 Bulk power supply

Table 22–7: Fuses

Fuse	Type	Function	Part number
F1	30A SB	AC secondary to CR3	29-26488
F2	30A SB	AC secondary to CR3	29-26488
F3	10A SB	AC secondary to CR1	90-07225
F4	10A SB	AC secondary to CR1	90-07225
F5	15A SB	AC secondary to CR2	90-07227
F6	15A SB	AC secondary to CR2	90-07227
F7		Not used	
F8	7A SB	Xformer mains input 240 VOLTS	90-07224
F9	20A FB	Supply reel +36v	90-08835
F10	20A FB	Take-up reel +36v	90-08835
F11	20A FB	Supply reel -36v	90-08835
F12	20A FB	Take-up reel -36v	90-08835
F13	20A FB	Capstan motor +36	90-08835
F14	20A FB	Capstan motor -36v	90-08835

22.3.1.4.1 CR1 and CR2 bridge rectifiers

Speed bulletin 533 has a tech-tip concerning the bridge rectifiers in the bulk power supply in the bottom of the drive. To summarize this safety related tech-tip - its says change CR1 and CR2 to 29-23311-00 at the next PM. This part number is the same as that which is used for CR3. So now all 3 bridge rectifiers are the same part number. It also says check the 3 bridge rectifiers for signs of overheating every six months. Read the tech-tip if you want clarification.

22.3.1.5 Microswitches

There is confusion over the microswitches, how to identify them and which goes where. There are only 2 types.

Table 22–8: Tx7x micro switches and part numbers

Dec Part Number	Pertec Number	Sw at ins H2O	Function	Location
29-23238	506-007	6	Vac Present	Top Middle of Vac Valve assy
	or 506-023		Column Limits	On stand off brackets
29-23239	506-008	2	Press Present	On the deck to left of Press Valve assy
			Tape on Reel	Middle right of Vac valve assy

22.3.2 Loss of Vacuum Faults

This article by Jim Egginton . . .

22.3.2.1 Loss of Vacuum on a rewind at EOT Intermittantly

22.3.2.1.1 Stiction - tape sticking to the head

The tape comes to a rest after a long run forward heating up the head, then on rewinding, in spite of the forward hitch, the tape sticks causing capstan slipage for a while, then when the head suddenly releases the tape after a certain amount of tension, breaks vacuum.

SYMPTOMS

- Large cracking noise at beginning of REW run
- Sometimes breaks tape
- Sometimes wraps tape round capstan wheel
- Customer using Scotch 777 tape (cheap but not back coated)

FIX

- Change head
- Clean capstan wheel
- Throw away tapes that had failed, as they will fail again when problem is fixed.

22.3.2.1.2 Capstan Slippage

If the capstan wheel is going to slip it will do so at the beginning of a REW run when the max torque is applied to it. Once slippage takes place the tape becomes very shiny and it is easier for it to slip. The tape then inches forward whilst the capstan is at full speed until it suddenly grips the tape and breaks vacuum.

SYMPTOMS

- Capstan motor racing at EOT with no tape movement.
- No signs of stiction, on the tape (i.e. lines of oxide stripping/build up)

FIX

- Clean or replace capstan wheel

22.3.2.1.3 Faulty Capstan Motor

When the capstan motor is about to pack up it tends to be noticed once again at this point. The ramp up to speed is too fast so the motor stays stationary then suddenly bursts into life breaking vacuum.

SYMPTOMS

- No capstan motion or whine on rewind then, suddenly breaking vacuum

FIX

- Change capstan motor

22.3.2.2 Intermittant Loss of Vacuum on Read/Write

The causes could be many and varied however the following apply.

22.3.2.2.1 Loss of air bearing pressure

SYMPTOMS

- If air bearing pressure goes intermittantly this is very often the only complaint by the customer. Also the tape will very often not autoload properly.

FIX

- Check the belts.
- Check the pipe coming out of the compressor, this rapidly heats and cools all the time and therefore the polythene hardens and cracks here.
- Check the pipes, and solenoid and spool valves in general.

22.3.2.2.2 Loss of vacuum

FIX

- Belts.
- Solenoids.
- Pipes.

22.3.2.2.3 Static build up on vacuum column rails

SYMPTOMS

- Erratic tape loop movement with continuous tape movement.
- Cracking and banging noise as tape goes into corners etc. and is then released.
- Tape loops etc set wrong. This fault can cause the settings to change on a day to day basis i.e. so-and-so set the tape loops up yesterday and today they are wrong again.

FIX

- Temporarily. Clean column rails with an antistatic spray or texpads very vigorously, making sure all oxide deposits are removed.
- Permanently. Renew vacuum column rails or linings of the rails.

Note
This has happened to all old drives which undergo heavy useage. As time goes on therefore we must expect this to happen to all machines.

22.3.2.3 Loss of vacuum at the end of a rewind (BOT)

22.3.2.3.1 Cripple Reel Problems

At the end of a rewind the TU reel is going at maximum speed (speed is governed by the capstan). If the TU reel cannot go fast enough the tape loop is seen to drop to the cripple reel port. This causes rewind speed to reduce temporily to 125 ips (from 350 ips). The result is that the tape loop appears to bounce up and down off the cripple reel port. If this movement is too violent however the interlock will make and loss of vacuum result. Some machines exhibit this cripple reel bounce and cannot be cured of it (circa Pat Keene); indeed that's why Pertec introduced the cripple reel port. Cripple reel bounce should only occur in about 1 machine in 20 and then only for a few seconds before speed is reduced by the low tape sensor on the TU reel.

FIX

- Check cripple reel micro switch works ok.
- Replace TU reel motor if cripple reel bounce occur for more than a few seconds.

- Check mains tappings are correct (unregulated supply to reel motors).
- Check rewind speed. There is a S.O.T. resistor on the M2 PCB for this.

22.3.2.3.2 BOT Problems

BOT failures can appear as loss of vacuum faults because, if the BOT sensor is aligned/adjusted marginally, it will be recognised going forward on a load but not when in reverse after a rewind. If BOT is not seen then loss of vacuum is seen when the end of tape slips free. There is so much tape arround at this time it appears as a genuine loss of vacuum, and is usually reported as such. Also if the low tape sensor is not working, then the BOT will be approached at 350 ips and may not be seen, or if it is seen, stops the capstan motor so quickly that the vacuum is lost.

FIX

- Check whether BOT had been passed after loss of vacuum.
- Go forward and reverse to BOT a few dozen times to check for BOT.
- Adjust the BOT sensor azimuth and distance for maximum volts (Physical movement of sensor).
- Check that the low tape sensor works.

22.3.2.4 General Items

Other non specific items to watch for with loss of vacuum are.

1. Dead spots on the vac col transducers (these are resistance track potentiometers).
2. Intermittances in the Reel Servo loops. The exact reel servo can be isolated by finding out which microswitch broke vacuum. Items to bear in mind are the motors and reel servo PCB, and dont forget tape reel to hub slippage.
3. Vibration arround the glass buffer box area. If the glass plates do not seal properly on the column rails then knocking the machine will cause loss of vacuum when the tape is moving. Check that all the screws are tight; that all the glass plates seat nicely on the rails; that no clips foul on any parts especially arround the pucker pocket; and that the buffer box door is adjusted properly (The large floating glass plate just catches on the top of the rail when the door is being closed).
4. The interlocks themselves. Although the interlock microswitches themselves are doubled up and therefore unlikely to cause failure individually, items to watch for are; loose wires on the microswitch terminals (or badly crimped wires); loose or broken pipes
5. If the reels are seen to have erratic movement check the air bearing pressure, and the pucker pocket.

22.3.3 TU77/TU78 load creep

This section by Jim Eggington/Brian Hailstone . . .

This is a problem in the load cycle, between the "tape on reel" point and BOT.

Normally, after the load button is pressed, the tape threads onto the take up reel, and then runs forward until BOT is sensed, when the vacuum valve changes over and set loops occurs.

If the load creep problem is evident the forward motion (going forward to BOT) goes slowly or stops, i.e. the tape creeps forward. It does this under high tape tension. If BOT is reached, set loops occurs and the action continues as normal. There is a long time out period on this faulty action, eventually bringing on the load fault light, but the flow chart for this does not point in the right direction. There is also the danger of the vacuum solenoid burning out before the time out occurs.

Once load creep has started it will continue even if the signal returns, until one the following happens:

1. Reset is pressed
2. BOT is reached
3. The m/c eventually times out.

There are two causes of load creep as follows:

1. Improper sensing of "tape on reel". The take up reel has holes in it which sucks the tape onto it during tape loading. There is a microswitch on this air line and when all the holes on the take up reel are covered the vacuum level increases and the microswitch changes state.
   Causes:- Any part of the vacuum system, (in particular between the take up reel and the vacuum valve) or the tape on reel sensing system with its logic could theoretically be at fault. However the following are the most probable.

   • Tape on reel microswitch intermittent. (This is the rightmost, on the Vacuum valve assembly). For part number see Table 22–8

   • The plastic bung giving access to the take up reel motor shaft to reel bolts has become dislodged.

   • A loose or faulty (throwing to one side) vacuum belt.

   • Damaged vacuum hose.

   Normally pressure or vacuum valve faults will show up differently (in the load cycle), or not cause this symptom.

2. "Tape in path" intermittant. With the tape in path sensor not working at all, the tape will rewrap on the supply hub, and it will load fault or try again. If it is intermittant it may well cause load creep. The tape in path sensor works in conjunction with the BOT/EOT assy (provides the light source for it).
   Causes for this are:

   • Faulty/intermittant or badly aligned TIP sensor

   • Faulty/intermittant or badly aligned BOT/EOT sensor

   • Bad tape. If oxide is missing from a stretch of tape light will shine through it.

   • Interconnect F1 PCB

Once load creep is fixed, watch out for tapes that have been loaded with load creep present. The high tape tension stretches the tape and can make it narrower than half and inch, causing loss of vacuum arround BOT. It is best to shorten all these tapes.

22.3.4 Setup procedure on Tx78/Tx79

This section by Brian Hailstone...

The TU78/TA78 tape drives have recently been FCO'ed and this means that the adjustment procedure has been changed. TU79/TA79 drives have the same adjustment procedure as the FCO'ed TU78/TA78 drives.

The WRITE PCBA now has only one pot instead of six, and therefore the write current adjustment procedure is very different to the previous method. The other drive adjustments are unchanged.

There are two different methods for the read/write adjustments, one using an oscilloscope, the other using the new adjustment box.

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22.3.4.1 Adjustments using the test box (29-26619)

22.3.4.1.1 Initial set-up.

1. Power down the transport.
2. Connect the adjustment box as follows;
   - Red wire to U13 pin 3 on the preamp PCBA (+volts).
   - Green wire to U14 pin 3 on the preamp PCBA (-volts).
   - Black wire to ground wire on the preamp PCBA.
   - White wire to test points 1 to 9 as applicable during the adjustments.
3. Power up the transport.
4. Load a master output tape to BOT and place offline.
5. Set the AGC switch on the read PCBA to the off position (to the right on a Tx78, down on a Tx79).
6. Set the MIA switches as follows;
   - S1 = FWD
   - S2 = WRT
   - S3 = 6250
   - S4 = MAN
   - U196 = all switches forward (all 1's pattern)
7. Using a DVM, measure across TP2 (+), and TP24 (-) on the write PCBA. Adjust the pot (R103) on the write PCBA for a voltage of 4.5V + or - 0.1V.

22.3.4.1.2 Read gain adjustment

1. Place switch 3 on the MIA PCBA to the 1600 position.
2. Set the adjustment box to the read gain mode.
3. Connect the adjustment box white lead to test point 1 on the preamp PCBA.
4. Place the drive on-line. (The tape should now be moving forward, writing an all 1's pattern in PE mode).
5. Adjust track 1 pot on the read PCBA by watching the "high" and "low" LED's on the adjustment box. When both LED's are out or flickering with approximately the same intensity, the adjustment is correct.
6. Perform this adjustment for all nine tracks.
7. Place drive off-line, and rewind tape.

22.3.4.1.3 Write current adjustment

1. Move MIA switch 3 to the GCR position.
2. Install a jumper between TP7 and TP24 on the write PCBA.
3. Connect the adjustment box white wire to TP5 on the preamp.
4. Set the adjustment box to write current mode.

5. With the tape at BOT, place the drive on-line. (The tape should now be moving forward, writing an all 1's pattern in GCR mode).

6. Push the reset switch on the adjustment box. The "ready/high" LED will now be lit.

7. Rotate pot (R103) on write PCBA clockwise until the "ready/high" LED goes out. Ignore the "low" LED during this step. You have now located the calibration point.

8. Now turn pot R103 anti-clockwise. The "ready/high" LED light up again.

9. Continue rotating pot R103 anti-clockwise until the "ready/high" LED goes out. If you go too far, the "low" LED will light up. The adjustment is correct when both LED's are out or flickering with approximately the same intensity. This is the "95% output" point. **IF YOU TAKE MORE THAN 30 SECONDS TO PERFORM THIS STEP THE CALIBRATION POINT MAY HAVE DRIFTED.** Go back to step 8 if you have taken more than 30 seconds.

10. Remove the jumper from between TP7 and TP24. This sets the write current saturation to the "115% current" point.

11. Recheck the voltage between TP2 and TP24 on the write PCBA. An acceptable reading is between 4.3V and 5.5V.

12. Check the read gains as described earlier in this procedure as changing the write current can effect the read gains.

13. Set the AGC switch on the read PCBA to the AGC position (to the left on a Tx78, up on a Tx79).

14. Set the MIA PCBA switch S4 to the AUTO position, and switch S1 to the centre position.

15. The read gains and write current are now adjusted.

22.3.4.2 Adjustment procedure using a scope

22.3.4.2.1 Read gain adjustment

This procedure is unchanged, ie set each track to 1.25 volts peak-to-peak on the oscilloscope, while writing an all 1's pattern in PE mode on a Master Output tape.

22.3.4.2.2 Write current adjustment

1. Ensure the AGC switch on the read PCBA is in the normal position (AGC on).

2. Load a master output tape to BOT.

3. Using R103 on the write PCBA, adjust for 4.7 volts between TP2 and TP24.

4. Load the appropriate program for your formatter (see at the end of this procedure)

5. Start the program. The drive is now writing all 1's pattern in GCR mode.

6. Adjust R103 on the write PCBA anti-clockwise. The errors will start slowly and then go into a continuous state. See note on errors at the end of this procedure.

7. Adjust R103 at the midway point between where the errors start, and when they become continuous.

8. Record the voltage reading on the DVM. This is the minimum write current adjustment point.

9. Adjust R103 clockwise. The errors should stop as you rotate the pot and then start again as you continue to rotate the pot. The errors will start slowly and then become continuous.

10. Adjust R103 at the midway point between where the errors start, and when the become continuous.

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11. Record the voltage reading on the DVM. This is the maximum write current adjustment point.

12. Add the voltages recorded in steps 8 and 11 together, and divide the answer by 2.

13. Adjust R103 to this value.

14. Adjustments are now complete.

22.3.4.2.3 Programs for setup procedure

TM78	TS78
Hit enable key on keypad. "HELLO" will be displayed. Enter the following program in sequential order, by keying in the following commands	Disable port Ⓐ and Ⓑ switches. Plug in terminal into the ASCII port. Type ^C on the terminal until the TA78> prompt appears.
2 PAR 10 DEP	
0 PAR X DEP (X=Unit no.)	Type R KEYPAD
0 INS	at KEYPAD prompt, type
63 DEP NXT	
205 DEP NXT	GET 8
260 DEP NXT	PARAM
7 DEP NXT	DEP 4 10
360 DEP NXT	DEP 0 X (X = unit number 0,1,2 or 3)
4 DEP NXT	
12 DEP NXT	Type START when ready to do the adjustments
23 DEP NXT	
21 DEP	
Press 0 then STA when ready.	
Errors are indicated in the following ways ...	

1. The display count (on keypad or terminal) incrementing
2. A noticable audible change from the drive.

22.4 TU80/TU81/TA81

22.4.1 Error code 26

If you get error code 26 and follow the pathfinder it may not take you to the stage where you should replace the door interlock switch.

If you do get error 26 check that both poles of the door interlock switch are operating. Change the switch first if you have any doubt, as it is an easy bit to change quickly. The switch is in the kit, part no = 29-24355.

22.4.2 Error 52 and 53

If you get error code 52 or error code 53, then please check that the reel is not slipping on the hub. If you grasp the outside edge of the supply reel (use 2400ft reel) and try to turn it while holding the hub, there should be no slippage. If slippage does occur then this is likely to be the cause of error 52 or 53.

You might be able to stop the slipping by cleaning the pads on the hub, otherwise replace the hub. It is quicker to try changing the hub first rather than replacing the module called out in the path finder.

22.4.3 Air bearing cable orientation

If one of the air bearing cable plugs is reversed the mechanism still works but an offset voltage is applied, causing the wrong tape tension. This is very easy to do if there are no location tabs on the plugs.

This causes the following effects;

- Error code 12 on loading with small reels intermittantly.

- Using test 12/13 occasional failures, but also a vibrating noise that appears to emanate from the supply hub. Sometimes especially with edge damaged tapes, this vibrating noise is apparent when the tape is stopped but under tension.

- All the data faults that are inherent with low tape tension, i.e. a larger than normal number of soft errors; a susceptibility to bad tape and dirty heads.

This problem can look identical to a slipping reel on the hub.

To get the orientation correct, numbers are written on the deck plate, cable and PCB. However these are sometimes ambiguous or missing.

The correct orientation is as follows:
At the PCB end the open plug connections should be toward the PCB
At the transducer end the plug open connections should be facing away from the transducer.

Having said all this there is now a new type of cabling on the newer machines, these are oriented different to the above but are very difficult to put on the wrong way round.

22.4.4 Erase head cable orientation

The erase head wires must be connected the right way round. The white wire goes to the top, and the black to the bottom.

22.4.5 1000 line tacho

If you have to remove the 1000 line tacho from a reel motor you will need a very small allen key (35 thou). I did put one of these allen keys into the Welwyn kits.
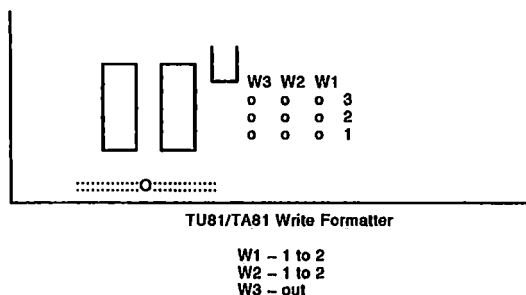
22.4.6 TU80 and Tx81 power supply

There is now a power supply that can be used in TU80, TU81/81E or TA81. The new power supply is 29-26372. This replaces 29-24220 (TU80) and 29-24753 (Tx81).

If you have to replace any of the power supplies you MUST check that it is configured correctly for 240v 50Hz. Just because the label on the outside says 240 volts don't take it for granted that it is set for 240 volts inside. See the pocket service guides for details of the voltage selection card.

22.4.7 Tx81 Write Formatter PCBA

There is more than one version of the Tx81 write formatter PCBA (29-24708) and the layout and position of the jumpers are different. The pocket service guides show one layout and Figure 22–1 shows another.

Figure 22–1: Write formatter

TU81/TA81 Write Formatter

W1 – 1 to 2
W2 – 1 to 2
W3 – out

22.4.8 Tx81 Servicing

This section by Jim Egginton

22.4.8.1 Head/Media Problems

Test 01 runs various routines, one of which is designed to test the Tx81 for excessive soft errors. Test 01 has previously basically tested in PE and GCR at both 25 and 75 ips, and now chooses the worst case of 75 ips GCR for data reliability. This test involves writing the ARA burst, qualifying it, then writing from BOT to EOT and counting the number of bad spots encountered. If more than 32 occur before EOT is reached then Error 04 Sub Code 38 shows. Bad spots can be seen by the reels going back and then forward as the transport does a reposition to write an EIRG (extended inter record gap). This therefore gives a go/no go appraisal of performance, to get a more accurate view, run test 26 (this is the above test 01 routine) a few times on the same bit of tape and note the place on the tape repositions occur, and how many times it does so. A reposition at the same place is an indication of a bad spot on the tape, though beware that degraded performance will show up bad spots that otherwise would not have been seen.

22.4.8.2 Test 91

Test 91 is basically the same as test 01 except that the tape needs to be loaded to BOT before it is run. If you select option 7 on test 91 the display will display the number of retries as they occur. This will enable you to see how many soft errors occured on that reel of tape.

To set an option for the Tx81 tests, first enter the test number in the normal way then press CE and EXECUTE simultaneously, then use STEP to select the option number. Press EXECUTE when ready to start the test.

22.4.8.3 Pathfinder Test 54

The TU81/TA81 pathfinder gives no details of test 54 though it does list it at the beginning of Section 2. This test is very useful in fault finding marginal faults, of excessive soft errors.

Test 54 is run by entering test 54 then pressing EXE four times, to reveal four values. Whilst a value is displayed it can be changed by entering a number in the ordinary way and pressing EXE to move on to the next value. However link W1 on the Servo Control Mod must be in the 1-2 position to allow writes to the EEPROM.

These four values are **write currents** as follows.

1. PE 25 ips

2. PE 75 ips

3. GCR 25 ips

4. GCR 75 ips

This returns hex numbers, however the display cannot interpret the letters of hex. Here is the interpretation.

Figure 22–2: Hex symbols for test 54

The highest values you should see are the following, as a general guide lower values are better, but it does depend on the head characteristics.

Table 22–9: Highest values for test 54

Value	Hex	Decimal
1	AE	174
2	BA	186
3	4E	78
4	5F	95

Values tend to increase as the head wears (as do TU78 values for margining the write currents).

If you know the transport is basically functioning OK and want to isolate the FRU that is displaying poor performance, then follow this procedure. It sounds long winded but it is not once the idea is gained. Make sure W1 is in the 1-2 position. Check the head is clean.

1. Run test 54 and note readings

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2. Run test 64 then test 54. If the readings have changed, then something has altered since it was last run.

3. Change the item to be tried for poor performance e.g. tape, head, write driver, read Amp.

4. Run test 64 and 54 again. If the readings change drastically, it may now be fixed.

5. Run test 31 to set up the read gains to finish.

6. If tests 64 or 31 will not complete then put the original write current values back, using test 54, to fault find.

Do not forget to put the servo pcb link W1 back to the 2-3 position, before switching off the drive.

22.4.8.4 Multiple hard Read/Write Faults

If the pathfinder shows hard errors 1 through 7 and the servo tests run OK (tests 03, 58, 59), and the pathfinder is followed to completion, then you may have a multiple fault, or a DOA module in the kit. Changing all the modules at once is unlikely to work as the modules are changed so often due to the pathfinder technique. A usual failure is 04 which could be any PCB except the TMSCP/SDI module.

A common multiple fault is the read head cable being broken whilst replacing a PCB, this cable is very delicate and should be disconnected from the read PCB before the screws are undone to extend the PCB set, as the cable is not long enough for the PCBs to be extended. There is an FCO to clamp the read head cable, to help prevent this, see Table 22–11

The read cable has a non insulated earth wire running along it, and it is this that breaks at the plug. The break cannot normally be seen too easily and only shows when the cable is flexed, so it is best to meter it.

22.4.8.5 Scoping for multiple faults

Scoping will allow fault finding of multiple faults and read head cable failures. Note it is only useful for hard faults where the test will not start, soft errors should be tackled as previously covered.

Look at the following test points and try to work out where in the chain there is a fault.

Useful tests are:
  21 Write PE 25 ips
  23 Write PE 75 ips
  25 Write GCR 25 ips
  26 Write GCR 75 ips
  22 Read 25 ips
  24 Read 75 ips

To set the transport up for scoping:
  enter test 26 with
  option 2 (press CE and EXE; then step 2) for loop on error
  press EXE - test will now start; but it will only be writing for a short while in its cycle of retrying, if there is a fault.

Scrutinise the **Read Amp Module** (under the Write Driver Piggy back PCB which should be unscrewed and eased away to get at the read Amp). There are 9 chains of chips running down from the head side of the Read Amp to the side nearest you. See Figure 22–3 and Table 22–10 which shows channel 0 points.

The **Write driver Module**, has write head drivers that are darlington pairs with a head centre tap. These can be seen running down the board see Figure 22–4. These are driven from large 22 pin ICs (9 of), which have their input directly from the write Formatter.

Table 22–10:   TU81 scope points for channel 0

PCB	Scope Point	DC Volts	w/f pk-pk	What it shows	What to suspect from this point
Read Amp	TP103	+6v	2v	Final analogue w/f	Read Fmtr
Read Amp	IC J9 pin 6	-1v	2.5v	O/P second preamp	Read Amp/Head
Read Amp	C102 +ve[1]	-0.6v	100mv	O/P first preamp	**READ CABLE**[1]
Write Amp	Q14 & Q15 Collectors	+15v	8v [2]	Write driver o/p	Write Amp
Write Amp	IC A7 pin 21	TTL signal (5v)		i/p to write driver	Write Fmtr

[1]IF THE EARTH WIRE ON THE READ CABLE GOES O/CCT THEN ALL CHANNELS WILL HAVE +5V DC (WITH NO SIGNAL) ON THESE CAPACITORS. IF ANY OTHER WIRE GOES O/CCT THEN JUST THAT CHANNEL WILL HAVE +5V (WITH NO SIGNAL) ON ITS CAPACITOR
[2]The frequency on these collectors is not the signal frequency but the HF bias of 3 Mhz approx. Signal freq GCR 75 ips is approx. 0.5 Mhz. It is possible to see the signal on top of the HF bias, but not much reliance can be put on this

Note the way the read cable is isolated as faulty (footnote 1). Care should also be taken with the signal frequency: GCR at 75 ips it is approx. 0.5 Mhz; in PE at 25 ips it is 80 Khz. Only channel 0 is shown, it is left to the reader to find the other channels which are a parallel of channel 0.

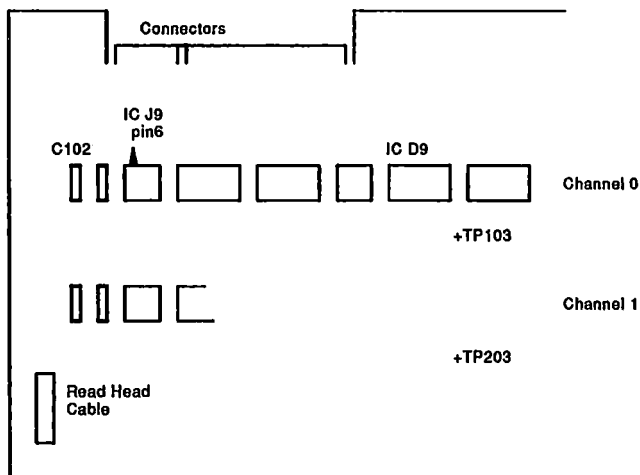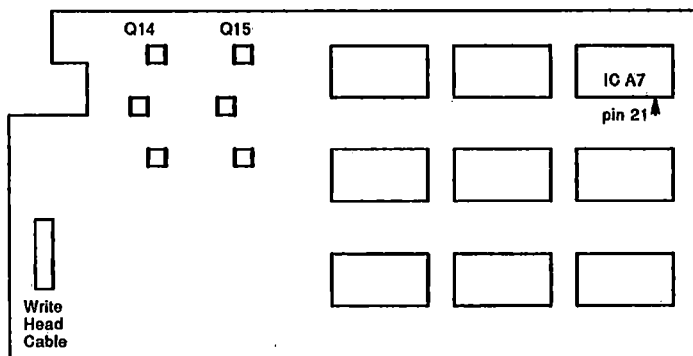**Figure 22–3:   Read Amp Scope Points for Channel 0**

Figure 22–4: Write Amp Scope Points for Channel 0

22.4.8.6 Heads

The heads are hard, very expensive, and with a design requirement to last virtually the tape drives lifetime. In the past there has been trouble with the heads, whereby the read write performance degraded after as little as a month, with no visible signs of wear. This was put down to undercutting the pole pieces by the tape (certain makes of tape were worse). A different design of head was put general use that attempted alleviate this, but the heads still did not always last as long as expected. The latest head is a ceramic design which should last much longer.

Table 22–11: Heads and awkward part numbers

.	CDC Part No	Dec Part No	Distinguishing point
Head New	77041293	29-30415-01	Ceramic head
Head	77034710	29-24752	Brass coloured metal between pole pieces
Head Old	77025380	29-24752	Plain metal between pole pieces
Read Hd Cable	77021041	29-26704	Brown ribbon cable
Write Hd Cable	77015562	29-27273-01	Grey ribbon cable
Cable clamp		29-26705	Stops cable breaking
Supply hub cover		29-25447	Black plastic cover

22.4.9 TU80 Scope points

These are not so useful as the TU81 waveforms, as there is only one board to do with read/write, and the same problems do not occur with the head and its cables. The read waveforms are of some interest these test points are quite prominent towards the bottom right of the RWS PCB. These are marked TP0 through TP8.

Edge track 1 is TP4 and edge track 9 is TP5, you can use these to test for skew.

The waveform on TP0 through TP8, can be described as a jagged sine wave of 120 to 200mV peak to peak, depending on speed.

22.4.10 TU81 vs TU81+ vs TA81

The TU81 and TU81+ (also known as TU81E) are the same except for the TMSCP I/F module. The TU81+ has a large buffer built into the TMSCP module to increase the chances of the drive being able to stream. The TA81 uses an STI I/F module in place of the TMSCP module.

Table 22-12: TU81/TU81+/TA81 differences

Drive	I/F module	System I/F
TU81	29-24707	M8739 unibus or M7740 Q-bus
TU81+	29-25797	M8739, M7740 or T1014 KLESI-B (BI)
TA81	29-25345	L0108-YB STI (HSC)

The TU81E (TU81+) is the only supported configuration that will attach directly to he VAXBI using the KLESI-B. Problems have been reported when configuring a TU81 using a KLESI-B. This is not a supported configation and will not work correctly. The TU81 can only be connected to the BI via a DWBUA and KLESI-U.

22.4.11 Converting a TU81 to a TA81

There is an upgrade procedure and an upgrade kit to do this, which is more involved than might be first thought.

the following is involved:

1. The interface in the Tx81 must be changed from a TMSCP to an STI module, or vice versa.

2. The interface to adapter cables are obviously different.

3. The power Amp ought to be a later rev for the TA81 (vendor 77041194 with black diodes)

4. The mounting hardware on the front fan assy is different, for extra cooling on the TA81 STI module.

5. There is an extra power supply cable for the STI interface from J10 of the power supply to extra pins on the STI interface W7P9, so this plug needs changing. The new wires go from J10 to W7P9 pins 10 and 11.

6. The control panels are different, in that the TA81 has port switches. However the cabling is the same for both control panels. A TU81 control panel can be temporarily used for a TA81, it will default to Port A.

22.4.12 TU81E TMSCP module revision - Apr 90

Some VMS systems are having problems with backup on TU81E's (TU81's are ok). PDP based systems appear to be ok. Changing the MSCP module to the latest revision can solve some of the problems. Some drives have had this module replaced for this reason, so it is important that the lower revision modules are not put back into these drives.

If you have to replace the buffered MSCP module in a TU81E (TU81+) please check the vendor part number on the old module and the replacement module. If the module you remove from the drive has a vendor part number of 77042457 then only replace it with a 77042457. If it has a vendor part number of 77042456 then replace it with a 77042456 or 457.

The Digital part number is the same for all versions of the module - 29-25797. You will need to ask logistics to check the vendor number for you before they ship it to you if you require the 457 version. Both versions are being shipped at present.

There are some 77042455 modules around. Always replace with a later version module:

22.5 Air Pressures for various tape drives

Readings in this table were taken with the gauges used for the TU78. The tubing does not always fit over the orifice to be measured. In these cases make up a temporary tube with blu-tack or similar.

Table 22–13: Air pressures of various tape drives

Tape	Point of measurement	Reading	Remarks
TU77	Vacuum soln	28 ins WG	System Vac
TU77	Compr soln	3.25 PSI	System Press
Tx78	Vacuum soln	34 ins WG	System Vac
Tx78	Compr soln	3.75 PSI	System Pressure
TE16	Tape cleaner	28/32 ins WG [1]	System Vac
TU80/1	Tape cleaner	8 ins WG [1]	Raw Vac supply
TU80/1	Outlet from Regulator	2.0/2.75 ins WG [1]	Pressure to air bearings
9400	Tape cleaner	22 ins WG [1]	Vac from Blower
9400	Vacuum columns	11.5/12.5 ins WG	Adjusted Vacuum

[1]Unpublished figures. These are typical figures that were taken from more than one transport

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22.6 TA90/TA91

This article by Brian Hailstone...

Only TA90/TA91 trained engineers should attempt to repair or install these options.

22.6.1 Product description

The TA90 is based on an IBM 3480 drive with the addition of two STI adapters and a different operators control panel. The TA91 is based on an IBM 3490. Each cartridge has a capacity of 200 megabytes. There is a automatic cartridge loader (ACL) which holds 6 cartridges (optional on the TA90).

The cartridge contains 550 feet of 1/2 inch tape. The tape has 18 tracks and the read/write density is 38,000 bytes per inch. Read/write tape speed is approximately 78 inches per second. This produces a maximum transfer rate of 2.7 megabytes per second. Rewind speed is 157 inches per second.

The minimum TA90 configuration consists of one TC90 TCU (Tape Control Unit) with one TU90 TTU (Tape Transport Unit). Each TA90 TTU has two transports. With the automatic cartridge loader option on both transports the subsystem gives an unattended capacity of 2.4 gigabytes (12 cartridges).

22.6.2 TA90 versions

There are currently two versions of the TA90, the original and the level II (also known as Bisbee) versions.

Functionally the two versions are identical. The level II version has been reconfigured so that the TCU has no logic cards in the top logic cage, and the TCU has a different power supply.

Another variant of the TA90 is the TA90E. This version has IDRC (Improved Data Recording Capability) which can increase the effective capacity by 100% or more. Current TA90's are field upgradable to a TA90E.

22.6.3 Configuration requirements

The subsystem requires a three phase mains supply. A TA90 consisting of 1 TCU + 1 TTU should have a 16 amp mains circuit breaker. The drive normally comes with a 32 amp mains plug fitted.

The TA90/91 connects into the HSC via a K.si (HSC5X-DA) requestor. The TA90/91 should not share the K.si with any other tape drive. The TA90/91 K.si's must be in the highest priority requestor slots (requestor 9 is highest priority in the HSC70, requestor 7 in the HSC50).

The TA90/91 has two STI adapters, with each adapter having two ports (A and B ports). These adapters (also known as FIPS-STI card) are effectively two independent formatters. One adapter (left hand) looking after the even numbered transports, and the other adapter (right hand) looking after the odd numbered transports.

22.6.4 Software requirements

The minimum levels required to support the TA90 is VMS V5 and HSC cronic V390.
The minimum levels required for the TA90E is VMS V5.3-2 and HSC cronic V500 (HSC40/70) or V400 (HSC50).
The minimum levels required for the TA91 is VMS V5.4-2 and HSC cronic V50A (HSC40/70) or V400 (HSC50).

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22.6.5 The K.si requestor

The K.si requestor (L0119, HSC5X-DA) is a direct replacement for the K.sdi (L0108-YA, HSC5X-BA) and the K.sti (L0108-YB, HSC5X-CA) modules. The K.si module can be used as a disk requestor or as a tape requestor. The default is as a disk requestor. If you want to use the K.si module as a tape requestor we have to tell the HSC that this is the case.

Enter the following HSC commands to configure the K.si for tape usage.

```
HSC>RUN SETSHO
SETSHO>ENABLE REBOOT
SETSHO>SET REQUESTOR 9/TYPE=TAPE
SETSHO>EXIT
```

22.6.6 Terminology

The terminology used by IBM is somewhat different to what we use in Digital. This can lead to some confusion. Table 22–14 show some of the differences.

Table 22–14:   Terminology differences

IBM	DIGITAL
Card	Module or board
Board	Backplane
Module	Chip
Frame	1st level assembly (complete hardware assembly)
Gate	2nd level assembly (major subassembly)
Machine reel	Take-up reel
File reel	Supply reel

22.6.7 Part numbers

When a failure occurs on a TA90/91 and the correct troubleshooting procedure is followed, a FRU number (or a few FRU numbers) will be called out. The FRU to part numbers cross reference can be found at the start of the CARR-DR and CARR-TCU sections. Documentation that came with the early drives did not have this information. Table 22–15 gives a cross reference for FRU numbers to part numbers.

When IBM changes the revision of a part, they assign a new part number which is usually completely different to the current revision part number. The vendor part number in Table 22–15 may not be the same as the vendor part number in the IPB or on the part itself.

The levels that Table 22–15 refers to are;
Level I TA90 base only
Level II TA90 bisbee only
Level III TA91 only

Table 22–15: TA90 FRU to part number cross reference

FRU #	LEVEL	DIGITAL #	VENDOR #	DESCRIPTION
001		29-27056-01	13F3092	Threader assembly, pantocam
002		29-27101-01	6177923	Solenoid assembly, latch
003		29-27170-01	80X1242	Motor/tach assembly, file reel
003		29-29737-01	65F7026	Motor/tach assy, file reel, new style
004		29-27169-01	13F4795	Motor, machine reel
004		29-29736-01	65F7025	Motor, machine reel, new style
005		29-27089-01	4798959	Flange, machine reel lower
006		29-27079-01	4780523	Sensor, tape path A
007		29-27079-01	4780523	Sensor, tape path B
008		29-27108-01	13F5564	Latch assembly, cartridge
009		29-27078-01	4770135	Switch assembly, file protect
010		29-27079-01	4780523	Sensor, cartridge present
011		29-27083-01	4780609	Sensor, cart latched
012		29-27071-01	4529233	Decoupler, assembly
013		29-27110-01	6178970	R/W head assembly
014		29-27100-01	68X8075	Transducer assembly, tension
016		29-27102-01	4780564	Spring, cartridge latch
017		29-27107-01	6178958	Spring, plunger compression
018		29-27080-01	4780556	Spring, cart latch compress
019		29-27084-01	4780615	Spring, cart latch interlock
020	I,II	29-27138-01	6390355	Blower assembly, 50Hz
020	I,II	29-27139-01	6390354	Blower assembly, 60Hz
020	III	29-28900-01	39F5029	Blower assembly
021	I,II	29-27152-01	6496619	LED, message display
030	I,II	29-27105-01	6178689	Compressor assembly (50/60Hz)
030	III	29-28905-01	65F5849	Compressor assembly, 50Hz
030	III	29-28904-01	65F5848	Compressor assembly, 60Hz
031		29-27069-01	4479809	Regulator, pneumatic
032		29-27082-01	4780581	Filter, pneumatic output
033		29-27057-01	1765057	Filter, pneumatic inlet
034		29-27142-01	6460001	Hose assembly, air pressure
035		29-27143-01	6460002	Hose assembly, vacuum
039		29-27155-01	6850773	Hose, plenum supply
040		29-27068-01	4479804	Switch, pressure sensor
041		29-27067-01	4479777	Plenum, assembly (Incl's press sensor)
042		29-27154-01	6850769	Hose, decoupler pressure
043		29-27154-01	6850769	Hose, decoupler vacuum
044		29-27141-01	6390559	Hose, right guide bearing
045		29-27097-01	6177128	Hose, left guide bearing
045		29-27481-01	6850771	Hose, left guide bearing (old no.)
046		29-27225-01	6850772	Hose, tension transducer
047		29-27153-01	6850768	Hose, cleaner block, supply
049		FD-26188-01	8576695	Cable, logic board to power amp J2
054		29-27140-01	6390537	Flange, machine reel upper
058		29-27116-01	6272786	Backpanel drive logic, DCFOR
059		29-27157-01	13F3755	Logic card, power amp, DSPG
060	I,II	29-27104-01	6178268	Logic card, message display
060	III	29-28916-01	94F5908	Logic card, message display
061		29-27088-01	4798958	Hub, machine reel
062		29-27135-01	6384593	Logic card, read preamp, ICGTR
063		29-27134-01	6384585	Logic card, write funct, ICJC
064		29-27115-01	6272338	Logic card, write power, ICNN
065		29-27145-01	6460037	Hose assembly, compressor

Table 22–15 (Cont.): TA90 FRU to part number cross reference

FRU #	LEVEL	DIGITAL #	VENDOR #	DESCRIPTION
071	III	29-28900-01	39F5029	Fan compressor
082		29-27483-01	6850795	Switch, plenum assembly thermal
084	I,II	29-27151-01	6460493	Switch assembly, local/remote
084	III	29-28910-01	65F5878	Switch assembly, local/remote
085		29-27162-01	68X8145	Logic card, drive cont, DD01R
086		29-27160-01	13F6232	Drive assembly, 3.5" IML diskette
095	I,II	29-27098-01	13F4255	Power supply, TU (50HZ)
095	I,II	29-27099-01	13F4244	Power supply, TU (60HZ)
095	III	29-28925-01	67X8453	Power supply, TU (50HZ)
095	III	29-28927-01	67X8369	Power supply, TU (60HZ)
096		90-08279-00	1767881	Fuse, 12A medium-blow (TTU F1, F2)
098		90-07222-00	512137	Fuse, 5.0A slow-blow (TTU F3, F4)
099			303549	Fuse, (TTU F5, F6)
100		90-07218-00	338165	Fuse, 3.0A slow-blow (TTU F7, F8)
101			433557	Fuse, (TTU F9, F10)
102		90-07210-00	111255	Fuse, 0.75A fast-blow (TTU F11, F12)
104	I,II	29-27175-01	8576672	Switch, DC control
104	III	29-28915-01	67X9171	Switch, drive lower
105		29-27075-01	4529282	Switch, online/offline (Drive)
107		29-27074-01	4529281	Switch, reset
108		29-27062-01	4451583	Switch, drive address front
109	I,II	29-27094-01	6050639	Logic card, msg disp sw, DSWI
109	III	29-28899-01	65F5010	Logic card, drive op panel, BDSI
110		29-27483-01	6390584	Switch, drive thermal
111	I	29-27095-01	6050647	Logic card, read ECC, KDEC
111	II	29-27605-01	13F1866	Logic card, read data flow, CRSD1
111	III	29-28902-01	65F3810	Logic card, read data flow, CRAD0
113	I,II	29-27159-01	13F5671	Logic card, buffer store, KFSA
113	III	29-28931-01	67X9223	Logic card, buffer memory, KFSA0
114	I,II	29-27137-01	6390118	Logic card, buffer control, KGBC
114	III	29-28932-01	67X9227	Logic card, buffer control, KGBC0
115	I,II	29-27148-01	6460300	Logic card, maint adapt, KUMI
116	I	29-27133-01	6384583	Logic card, write data, KDWD
117	I,II	29-27136-01	13F3752	Logic card, microprocessor, KUPR
117	III	29-28920-01	65F5044	Logic card, microprocessor, CRPA0
118	I	29-27163-01	68X8148	Logic card, dev adapt, KUDI
118	II	29-27606-01	13F1872	Logic card, write data flow
118	III	29-28929-01	67X9218	Logic card, write data flow
119	I,II	29-27112-01	6272316	Logic card, read control, KDRC
120	I,II	29-27150-01	13F2194	Logic card, buffer adapt TA90, KGBB
120.	I,II	29-27900-01	13F5711	Logic card, buffer adapt TA90E
120	III	29-28903-01	94F8303	Logic card, buffer adapt, CMPTO
121	I,II	29-27164-01	68X8149	Logic card, stat store, KUSM
121	III	29-28917-01	88F1073	Logic card, stat store, KCRSSO
122	I,II	29-27147-01	6460283	Logic card, stat store, KUST
123	I	29-27093-01	56X4626	Logic card, read skew 1, SBCR
124	I	29-27093-01	56X4626	Logic card, read skew 2, SBCR
125	I	29-27093-01	56X4626	Logic card, read skew 3, SBCR
126	I,II	29-27174-01	13F4817	Logic card, power on reset, KRST
127		29-27081-01	4780567	Interlock, cartridge latch
129		29-27062-01	4451583	Switch, drive address, rear
130	II	29-27149-01	13F4829	Logic card, read detect, NCRD
130	III	29-28930-01	67X9222	Logic card, read detect, NCRD0

Table 22–15 (Cont.): TA90 FRU to part number cross reference

FRU #	LEVEL	DIGITAL #	VENDOR #	DESCRIPTION
133		29-27166-01	68X8152	Logic card, channel adapt A, KUCJ
134	I,II	29-27165-01	13F1768	Logic card, control store, KUFG
134	III	29-28919-01	94F5853	Logic card, control store, CRC10
135	I,II	29-27168-01	6256798	Logic card, cont store, WST
138	I,II	29-27171-01	82X4222	Logic card, dual regulator, KREG
139	I	29-27113-01	6272321	Backpanel A1 KAA1
140	I	29-27114-01	13F3757	Backpanel A2 KAA3
140	II	29-27604-01	39F3363	Backpanel A1 KAA4
140	III	29-28918-01	94F5897	Backpanel A1 CRB10
141	I,II	29-27472-01	13F4195	Logic card, TCU op panel, DSWB
141	III	29-28926-01	65F5900	Logic card, TCU op panel
142		29-27482-01	8576311	Logic card, TCU op panel, KWSA
143		29-27076-01	4529300	Switch, L/G lower thermal
144	I,II	29-27087-01	4798931	Power supply, TCU AC 50HZ
144	I,II	29-27086-01	4798865	Power supply, TCU AC 60HZ/50HZ Japan
144	III	29-28907-01	67X8462	Power supply, TCU AC 50HZ
144	III	29-28906-01	67X8461	Power supply, TCU AC 60HZ/50HZ Japan
145	I	29-27072-01	4529249	Power supply, TCU DC 50HZ
145	I	29-27073-01	4529250	Power supply, TCU DC 60HZ/50HZ Japan
145	II,III	29-27603-01	1037500	Power supply, TCU DC 50/60HZ
146		90-07222-00	512137	Fuse, 5.0A slow-blow (TCU AC PSU F1)
147		90-07221-00	5214419	Fuse, 5.0A fast-blow (TCU DC PSU F1)
148		90-07216-00	615683	Fuse, 2.0A slow-blow (TCU DC PSU F2)
150		29-27060-01	2546929	Fan assembly, TCU gate
151		29-27060-01	2546929	Fan assembly, TCU gate
152		29-27166-01	68X8152	Logic card, channel adapt B, KUCJ
161		29-27061-01	4054243	Cleaner, block assembly
162	I	29-27103-01	6178230	Switch assembly, DC service
162	II	29-27741-01	13F1692	Switch assembly, DC service
162	III	29-28921-01	65F3725	Switch assembly, DC service
197		29-27063-01	4451584	Switch, TCU channel address
198	I,II	29-27064-01	4451772	Switch, assembly EUPO
198	III	29-28911-01	4451772	Switch, assembly EUPO, front/rear
199		29-27173-01	13F3765	Write bus terminator
212		29-27156-01	6850774	Hose, vacuum supply
215		29-27097-01	6177128	Hose, tape lifter solenoid
216		29-27111-01	13F4792	Solenoid assembly, tape lifter
218	I,II	29-27176-01	8576678	Power box, TU AC 60HZ/50Hz Japan
218	I,II	29-27178-01	8577037	Power box, TU AC 50HZ
218	III	29-28909-01	67X8470	Power box, TU AC 50HZ
218	III	29-28908-01	67X8465	Power box, TU AC 60HZ
219		29-27065-01	4479762	Tee, vacuum distribution
223	I,II	29-27177-01	8577034	Bellows, convoluted
224		29-27059-01	2277060	Switch, logic gate thermal
225		29-27096-01	6177111	Sensor A, machine reel
226		29-27096-01	6177111	Sensor B, machine reel
227		29-27476-01	4780536	Guide, machine reel
228		29-27479-01	6178948	Guide, left tape
229		29-27477-01	4780538	Guide, right tape
230		29-27100-01	68X8075	Transducer assembly, tension
231		29-27478-01	4780540	Guide, center tape
258		29-27179-01	Table 22–16	Diskette, IML functional
262		29-27146-01	6460067	Hose assembly, pressure test port

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Table 22–15 (Cont.): TA90 FRU to part number cross reference

FRU #	LEVEL	DIGITAL #	VENDOR #	DESCRIPTION
263		29-27144-01	6460003	Hose assembly, vacuum test port
272	I	29-27471-01	13F3739	Logic card, load resistor, BLCR
273	III	29-28928-01	67X8826	Switch box, compressor AC
277		29-27109-01	6178969	Guide, head compliant
278	I	29-27149-01	13F4258	Logic card, read detect, NCRD
280		90-07216-00	615683	Fuse, 2.0A slow-blow (TTU F13, F14)
281		29-27161-01	13F2223	Logic card, ACL control, DST1
282		29-27172-01	13F4824	Loader assembly, ACL deck
283		29-27091-01	56X4441	Motor, loader
284		29-27122-01	6272886	Sensor, load complete
285		29-27473-01	13F5571	Mechanical final assembly, ACL
288		90-07214-00	78951	Fuse, 1.6A slow-blow (ACL)
289		29-27130-01	6273036	Sensor assembly, stack low position
290	I,II	29-27092-01	56X4462	Input stack assembly, loader
290	III	29-28913-01	67X8897	Input stack assembly, loader
291		29-27122-01	6272886	Sensor, cartridge in stack
292		29-27132-01	6315281	Sensor, cartridge staged
293		29-27128-01	6273033	Rail assembly, ACL left input
294		29-27129-01	6273034	Rail assembly, ACL right input
295		29-27123-01	13F4796	Feed assembly, auto cart loader
296		29-27122-01	6272886	Sensor, stack up position
297		29-27125-01	6272903	Output stack assembly, ACL
298	I,II	29-27126-01	13F5446	Operator panel (ACL)
298	III	29-28924-01	65F5015	Operator panel (ACL)
299		90-07221-00	855251	Fuse, 5.0A fast-blow (ACL)
900		54-18310-01	DEC	STI adapter module, left
901		54-18310-01	DEC	STI adapter module, right
903		29-27409-01	82X5091	Power supply, STI adapter PS03
904	I,II	29-27474-01	13F5609	Fan, STI adapter cards
904	III	29-28933-01	65F5896	Fan, STI adapter cards
905		29-27059-01	2277060	Switch, STI upper thermal
906		29-27070-01	4487509	Switch, STI lower thermal

Table 22–16: Diskettes, part numbers and revisions

Functional	Rev-Vendor #	Support	Rev-Vendor #
29-27179-01		29-27158-01	
	65F4151,EC:C34863		67X9034,EC:C69940
	F01-65F7016,EC:C34862J		H01-65F5887,EC:C34398A
	E01-13F6255,EC:C04861K		F01-13F5722,EC:C12686G
	D03-13F5657		E01-39F4751
	C03-13F8065		D01-31F6819

Table 22–17: Tool part numbers

Part no	Description	Part no	Decscription
29-11650-00	Pressure gauge 0-40	29-27268-01	Vacuum gauge 0-150
29-27466-01	Card extractor	29-27465-01	DC test tool
30-30326-01	Cleaning cartridge	29-27469-01	Hose clamp
29-27470-01	File protect gauge	29-27468-01	Leader replace kit

22.6.8 FCO information

FCO TC90-F001 EQ-01571-01

The first shipments of the Bisbee version had to be installed so that only the B port was connected. This was due do a noise problem causing high data error rates if port A was used. This has been corrected by an FCO to the two STI adapter modules. Only TC90's at revision B03 are affected. This FCO brings the TC90 to revision B04. This FCO is not required on non-Bisbee versions.

FCO TA90-O001 EQ-01587-01

This FCO fixes a few problems. It includes new PROMS for the STI adapter modules and new floppy diskettes. This brings the formatter µcode to V2-3. All TA90's should have this FCO done. By doing a SHOW TAPE on the HSC you can see what value is returned in the FMC field. This is the µcode revision level, and 23 = V2-3.

FCO TA90-O002 EQ-01637-01 and -02

This FCO has 3 separate "fixes".

1. Lubricate loader guide shaft with KRYTOX grease.

2. Prevent the power harness chafing against the compressor.

3. Replace connecting rod in the loader.

Microcode update 22-01015-01

This is not an FCO, but all drives should have this latest version of microcode diskette installed. This is microcode version C34863.

This version will check that the parity switches on the TCU PCB's have been set up correctly. A warning message will flash on the pod panel if the switches are set up incorrectly.

22.6.9 Old Factflashes

22.6.9.1 TA90E upgrade gotcha - Dec 90

TA90E Upgrade Installation changes Unit Characteristics, requiring a CLUSTER REBOOT . Make sure the customer is aware of the situation before you begin the upgrade.

22.6.9.2 TA90/91 Long tapes vs new microcode - Aug 92

New microcode, version "863" was released in 1992 for TA90's and TA91's. (The microcode is loaded into the TA90/91 from floppy at IML time). This microcode can be using part number 22-01015-01 for TA90/90E and 22-10796-01 for TA91.

This version of microcode checks the length of the tape in the cartridge to make sure that it is not too long. If it is, the drive gives the following error and the cartridge cannot be used. Advise your customers to only use tapes of the recommended length (550 feet).

• Sense byte 03: 5A

• Sense byte 10: A0

• Sense byte 11: 39

This microcode also causes the drive to give the following error if a cartridge that has been written on a 36 track drive is used. The drive will "hang" and an IML will be necessary. If the failing cartridge is bulk erased it should be ok to use again.

• Sense byte 03: 5C

• Sense byte 10: 65

• Sense byte 11: 71

22.7 TZ30, TK50 and TK70

22.7.1 TZ30 leaders become jammed - Unload Problem

This has found to be caused by defective 3M cartridges. The problem will be reported by the customer as a failure to unload the cartridge, (error lights blinking).

The problem is caused by the manufacture of the cartridge covers at our supplier 3M. The source of the problem has been rectified .

The following 3M cartridges are affected:
5 digit ID codes, xx212 thru xx239 stamped on the bottom cover.

Sometimes pressing the UNLOAD button 3 or 4 times will unload the tape. **The customer should be advised to do this on all TZ30 stuck tapes, before an engineer visit.**

Failure to recover will require a manual unbuckling of the leaders in the drive. Customers who wish to have the cartridge replaced should be accommodated with a free replacement. The exchange process is being worked and will be communicated when finalised.

The TK50/70 does not exhibit any unloading problems with these cartridges. The TZ30 drives should not be replaced, unless the unload can be associated with a problem other than the cartridge.

22.7.2 TZ30 cartridges will not rewind - cartridge stuck in drive

The TZ30 reel servo mechanism is necessarily very compact, and only has just enough rotary power to move tape. If a sticky tape (due to being old or overheated) is in the drive it may not rewind. Also if the tape has been mistreated such that the tape has dropped in the cartridge so that it is catching against the case it may do this.

This symptom is such that after a power cycle the rewind starts then tape motion slowly stops and the fault light flashes. Very often the tape can be heard to be catching when rotating.

Repeated power cycles may get the tape back so it can be thrown away, or I have found putting the TZ30 on its side and power cycling gives the motors extra go.

22.7.3 TZ30 replacements hanging on Backup

Problem - TZ30 tape drives experiencing unacceptable periods of time performing multi volume Backup operations and have created unrecoverable read errors on tape cartridges during software installations on DecStation 5000 systems.

All reported problems have been experienced performing Backup operations on **MicroVax 3100 models 30,40,80 systems and VaxStation 4000 model 60 systems.** Unrecoverable read errors were experienced on DecStation 5000 systems performing Ultrix software installations.

TZ30 tape drives that are revision D05 only suffer from this.

22.7.4 The TZ30s bleep

You may have noticed that on **power on** the TZ30 bleeps, (who could have failed to hear it). This is an indication that the TZ30 has passed it's PUST (Power Up Self Test).

There is a problem, temporarily, that sometimes the TZ30 fails to bleep even though it has passed it's PUST OK.

This is being worked on as of Jan 91, and will be fixed in future TZ30s, I am assured, though it is not known when.
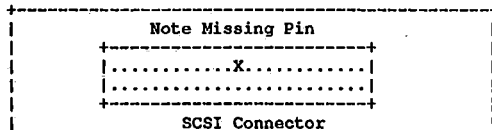
22.7.5 TZ30s fail PUST and bleep continuously on Power On in SZ12s

Thanks to Damon Parsons for resolving this.

This may be caused by the SCSI cable being installed onto the TZ30 drive the wrong way round, check the orientation of the cable, the following information can be used to check this.
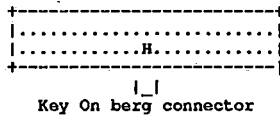
The TZ30 tape drive does not have a keyed plug for the SCSI cable, this means that the SCSI cable can be installed either way round, The correct way for the cable to be installed is for the the key on the berg connector to face outwards, towards the back of the drive. Also the TZ30 drive has a missing pin, this is the position where the hole next to the key on the berg connector should be placed, see diagram for a better explanation.

```
        Back underneath of TZ30 Tape Drive Controller Module

     +---------------------------------------------------+
     |                  Note Missing Pin                 |
     |        +--------------------------+               |
     |        |..............X...........|               |
     |        |..........................|               |
     |        +--------------------------+               |
     |                 SCSI Connector                    |

        NOTE: The missing pin X must be positioned in hole H.

   SCSI Cable Berg Connector

              +-------------------------+
              |.........................|
              |............H............|
              +-------------------------|
                        |_|
                 Key On berg connector
```

If the berg connectors on the SCSI cable (P/N: 70-28109-01) are oriented such as to make it difficult to install them on the TZ30 drive, (this looks like the wrong way to install the cable) then some force will be required to achieve this. If this is the case there is a danger of damaging the cable and/or the drive logic module.

This was due to a faulty batch of cables in SZ12s manufactured in AYR during mid 1992. New ones should be OK.

22.7.6 TZ30 Rev E06 and E07 - SCSI Chip problem update - Mar 93

The TZ30 had some problems with Backup and copy this summer when the WD33C93 SCSI chip went end-of-life and a newer, faster WD33C93A SCSI chip was substituted in drive revision E06.

The problem with certain lots of the WD33C93A chips was that they were almost twice as fast as the old WD33C93. These parts would steal time-critical processor cycles with several consecutive DMA cycles.

The interim fix was an effective screen of these faster parts. This was put in place in manufacturing (ZGO) in August. This screen proved to be very effective and all drives prior to the screen were purged in Stockroom 17.

In November, the firmware was modified so that consecutive DMA cycles were not possible without giving the processor cycle time. This fixed the problem, eliminating the need for a screen and was introduced into manufacturing as drive revision E07.

In summary, E06 and E07 drives are functionally identical and should work just fine in all applications.

22.7.7 TK50 SCSI B Phase Errors

WHEN

For these errors to show **ALL** the following conditions must be met.

1. BACKUP to a TK50Z on the SCSI B Bus

2. Multi volume Savesets

3. Submitted as a batch job

4. More than 3 minutes elapses between a tape finishing and the next tape being inserted.

WHAT

PKB0 will intermittently log PHASE errors followed by MKBxxx Device errors during the dismount and wait period between tapes.

The bus eventually resets and the backup continues as normal, so the customer is not impacted except that he sees some errors occurring. The backup should complete as normal.

WORK ROUND

None needed

RESOLUTION

A command file is available for VMS 5.2 through 5.4 from the CSC. This applies a patch to the MKDRIVER. Note that the system MUST be rebooted after the command file has been done, in order to use the new image. On successful completion this command file MUST be deleted.

22.7.8 Faulty TK50 cartridges - Apr 93

It has been discovered that a small quantity of defective TK50K cartridges produced in Jan. 1993 (10-380 pcs) were inadvertently mixed in with good product shipped to distribution sites. These defective cartridges may result in tape jams and/or tape damage when used in drives.

In order for the TK50K cartridge to qualify for this defect, BOTH the six digit lot code (3836nn) AND the five digit date code (nn304) must appear on the bottom of the cartridge, (where "nn" means any number).

Customer Services Engineers responding to calls involving TK50K cartridges with the above ID code combination, or otherwise finding evidence of their presence at a customer site, should advise the customer to return the cartridge to the point of purchase for free replacement.

22.7.9 Reading TK50 tapes on TK70/TQK70s

This only applies to:

1. VMS 5.5 , and is very often seen as **failing to install VMS 5.5 because TK70 on a TQK70 goes into Mount Verify**

2. TQK70s Rev D04 and appears to be a firmware problem

Restating this. This isn't a VMS 5.5 issue particularly, but only seems to have been around since VMS 5.5 came out. Distribution tapes written by TK50 or TZ30 tape drives will display intermittent problems when reading the data on a TK70 with a TQK70 controller at revision D04.

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Work Round

Use TQK70s revision C04. Engineering has been aware of this problem since Sept 1991. A micro code change will be developed to resolve the problem. PRISM case PRO7707.

Table 22–18:   Firmware and ROM Info

Rev C04	23-410E6-00	E27
	23-411E6-00	E28
Rev D04	23-610E6-00	E27
	23-611E6-00	E28

22.7.10 TQK50/70 LEDs At Power On

The two LEDs on the TQK50 (M7546) and TQK70 (M7559) at power on go through the self test routine. After this the bottom LED nearest the cable connector stays on. (D1 off, D2 on). At this point the TQK50 has PASSED it's self test.

When the system is booted both LED's go off after flashing. At this point the TQK50 has initialised in a TMSCP fashion. i.e. the packet structure is in place in main memory and the CPU can talk to the TQK50/70 intelligently.

The cookbooks etc suggest that D1 on, D2 off, is a failure. This is not the case between switch on and boot up.

All revisions of firmware do this.

22.7.11 TQK70 "Unused opcode interrupt error" FW problem

When doing a backup to a 2nd or later tape, VMS will ask the operator for the next tape in the backup to be loaded by means of an OPCOM message. The way this problem shows itself is that the operator cannot satisfy this request, it just keeps issuing OPCOM requests.

This only happens very occasionally on affected sites, and is a product of the application (swapping the hardware will not fix it). If the job is then aborted the tape drive is locked out and the vax must be rebooted for it to be seen again.

In the errorlog logged under PTA0 the above message is displayed from the SA register followed by "init sequence completed" and "sequence number reset". It can also show in the SA register as "single interrupt errors".

Very often the tape drive recovers and puts "unused opcode interrupt errors" in the error log, so if you see them, even though the customer has not complained the TQK70 should be changed.

This is a firmware bug on the TQK70, TK50s are not affected.

There is no FCO for this problem the TQK70 is replaced in the ordinary way, Rev D4 fixed this problem. (The firmware change was from Rev C4 to D4).

22.7.12 TK50/70 and the TD50 tester - Servicing Guide

There are two cookbooks on TKs, one from country and one from corporate. This factflash and cookbooks are available from the Welwyn District Data Base for copying in the usual way. However these are not up to date enough to cover the TD50 tester.

The cookbook referred to in the checklists is the corporate one.

The general idea of the guide is to aid fault finding, and to make sure most normal items are considered before the TK50 is put on outage. However a lot of faults show individual parameters, so it should be applied with intelligence.

One of the traditional reasons for sagas arising from TK50s is DOAs.
A typical case would run as follows:

A TK50 is faulty and is replaced with a marginal, or DOA, TK50.
Fault is re-logged and engineer replaces the TQK50. (The TK50 must be good as its new)
Fault is re-logged and the media is replaced. (Both TK50 and TQK50 are now presumed good)
Customer is now annoyed, call is put on ECSO, looked into and fixed. (TK50 replaced again)

To guard against this:

Always use the TD50 tester to test replacement TK50s do not presume them good.
Be careful when replacing TQK50s, for a reason such as "because the TK50 did not fix it".
Try to get good trouble statements, those such as "backup failed", lead to repeat calls. Use the TD50 tester to verify the drive and the media.

The TK50 must not be changed with the power on, by doing so a precedent may be set that following engineers will find awkward, and anyway it is bad practise, and cannot be done safely. This also applies to connecting up the TD50 tester.

22.7.12.1 Cleaning kits

There exists a cleaning kit for TK style tape cartridge devices.

This consists of a dummy cartridge to put in the drive, cardboard wands to push through it onto the head, and breakable glass phials containing the cleaning fluid (Applicators). They are simple to use, and adequate to clean heads.

If attending a fault call where the head is suspected of being contaminated the engineer should inspect the head first, and after cleaning. The leader should be cleaned as well.

Customers should be advised to use these on a regular basis, say once a week, or once a month, and after using a bad (failing) tape, that is whenever contamination is suspected.

Table 22–19: Part Numbers

Cust/Eng	Part Numb	Comments
Dec Direct	TKXX-HC	Cartridge + Wands + Applicators
"	TKXXR-HC	Wands + Applicators
Logistics	22-00436-01	Cartridge + Wands + Applicators
"	22-00436-02	Wands + Applicators

The TK85 has a different head cleaning cartridge. It is not possible with the TF857/TF837 to get the TK50 style cleaning cartridge in because of the loader. The TK85 has a cleaning cartridge that, when inserted in the drive is recognised as such, and the drive then goes through a certain routine to clean the head.

The TK50/70/TZ30 does not have these routines so if a cleaning cartridge of this nature had been available for it, the drive would come up with an error and not clean the head.

22.7.12.2 TK cartridges and heat

During hot weather we need to be vigilant with magtapes and in particular TK cartridges.

Above the temperature threshold of the tape, the binder (glue) holding the oxide particles to the mylar backing degrades causing the oxide to become loose. Subsequent cooling down of the tape will not stick the oxide back on to the mylar.

The temperature threshold for TK cartridges is 100 degrees F

The temperature threshold of open reel tapes varies from 90 to 130 degrees F depending on the grade (how much the tape cost)

In the summer these temperatures could easily have been exceeded in the boots of cars.

Tapes which have exceeded their temperature threshold will clog the head up with loose oxide and may not work (we have reports of this). In this case discard the tape and clean the head and tape path before returning the transport to the customer.

If you suspect a tape, then next time you try it be sure to check the head afterwards, and discard the tape if the head is dirty.

22.7.13 Checklist

I have ammended this to a single checklist December 91

The items are in some sort of order, but they should all be read and applied as necessary.

1. IS THE TK50 SHOWING ERRORS whilst you are on site. CAN THE ERRORS BE PINPOINTED. Use the TD50 and then check console logs, errorlogs, diagnostics, and customer inputs to determine the FRU. Remember the power supplies! If so rectify the fault in the normal way.

2. EXAMINE THE HEAD BEFORE CLEANING IT. , If it is contaminated, this may well be the cause, clean it, (cookbook Appendix A) and try to find the cause. Ask the customer which tape he was using when it failed, and the tape before. Verify one or two tapes with the TD50 (degaussed), and examine the head afterwards. See Cookbook chapter 1.5 for defective cartridges, but be aware any batch, or number of tapes could be bad.

3. IS THERE A LOT OF DUST in the TK50. If there is clean it out. Do not necessarily change the TK50. Try to educate the customer on dust prevention. Leave a cartridge in the drive, though beware leader damage can result, so use a scratch tape for this. Try to get the customer to take the system off the floor: a low table, blocks of wood, a sheet of plywood help a lot. If the carpet cannot be removed be sure it is regularly Vacuum cleaned, not brushed. See Note 1 below.

4. Ask the customer keep a LOG OF HIS TAPES, a card index or notebook is adequate, with a page for each physical tape. See Note 2 below.

5. If the media is in question (i.e. the errorlogs and symptoms do not preclude it), change all the necessary customers tapes. Batches of 6 tapes are kept in support for this purpose, but note that these are for loan to the customer, and this should be pointed out to him at the time. These tapes should be put in the exceptions loan file and tracked through ECSO by them, with the engineers prompting.

Notes

1. If the customer has done all he is able to resolve his dust problem, and it is still not adequate, then the engineer must try to set the customers expectations as to the frequency of fault calls on TK50s. A statement such as the following should be adequate.

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THE TK50 IS DESIGNED FOR THE GENERAL OFFICE ENVIRONMENT, HOWEVER WE HAVE NOTICED A GREATER INCIDENCE OF FAILURES IN DUSTY ENVIRONMENTS. WE APPRECIATE THE INCONVENIENCE THIS CAN CAUSE YOU, AND AS GENERAL GUIDE I WOULD ESTIMATE SERVICE CALLS SHOULD BE EXPECTED BETWEEN X AND Y MONTHS.

x and y values would be up to the engineer. It is my experience that for a very dusty environment 2 to 4 months, and slightly dusty environment 6 to 9 months between calls is normal.

2. The Tape Log should have a column each for:
   Date used
   Number of errors during run
   Amount of tape used
   Initials

This will help to find bad tapes before they become bad enough to contaminate the head (hopefully).

22.7.14 The TD50 tester

Notes on the running of the TD50 tester come with it and are complete. It is difficult interpreting the results and using the tester even though it has only one button, so some familiarization is required i.e. the training course.

The tester can be used to test the **TK50, TZK50, TK50Z and TK70** but not the TZ30. It is possible to use it on the new **TF85**, but new ROMs will be required for the TD50.

Table 22–20: Parts to be kept in/with the TD50 Tester

Part No	Part	Comment
70-21142-01	TK50 head	
70-23482-01	TK70 head	
30-32097-01	Test tape	Does for both TK50 and 70. There used to be separate ones
74-28268-01	TK50/70 leaders	
22-00436-01	Head cleaning kit	
22-00436-02	Refill for Hd clean kit	
12-22895-00	Head springs	
TK50-AX	Tape Drive	
TK70-AX	Tape Drive	

Tools		
FC-10150-AC	TD50 tester with case	
29-24647-00	Degauser 240v	Needs 13A plug
BC16E-10	MMJ Cable	Tester to printer/VDU
H8571A	Converter	RS232 female to MMJ
H8575A	Converter	RS232 male to MMJ
17-01047-01	Berg to Berg cable	Data cable, tester to TK50

Digital Internal Use Only

22.8 TF8x, Tx8x7 and SA10x series

22.8.1 General Information

The TK85 is the tape drive that is fitted in all of the products of the type Tx8xx. It is a TK85 because it has a TK bus coming out the back of it of the type used in the TK50 and TK70 (note not the TZ30 which has a direct SCSI interface). There is no QBus interface for the TK85 i.e. there is no TQK85, so it does not exist as an option on its own, it is always in its DSSI TF, STI TA, or SCSI TZ forms.

22.8.2 Part numbers for Tx8xx series products

Table 22-21: Part numbers of main FRU's

Part description	Part number	Used on - see below
Tx85 in loader configurations	TK85-AX	e,g,i,k,m
Tx85 with no loader	TK85-BX	a,c
Tx86 in loader configurations	TK86-AX	f,h,j,i,n
Tx86 with no loader	TK86-BX	b,d
Controller module, SCSI	54-19122-01	c,d,e,f,i,j,m,n
Controller module, DSSI	54-19089-01	a,b,g,h,k,l
Loader transfer assembly	29-28102-01	e thru n
Power supply, 240v	29-28103-02	e thru n
Operator control panel	29-28104-01	e thru n
Handle motor assembly	29-28106-01	e thru n
Fan	12-23374-13	e thru n
STI-SCSI adapter module	30-37153-01	e,f,i,j
STI-SCSI adapter power supply	30-37150-01	e,f,i,j
Magazine	30-32447-01	e thru n
Leader replacement kit	70-28824-01	a thru n

a. TF85

b. TF86

c. TZ85

d. TZ86

e. SA100

f. SA106

g. SF100

h. SF106

i. TA857

j. TA867

k. TF857

l. TF867

m. TZ857

n. TZ867

Digital Internal Use Only

22.8.3 Different drive part number for loader

TK85-AX or TK86-AX is for LOADER USE ONLY, (Tx8x7, SA10x).

TK85-BX or TK86-BX is for embedded and Table top use, (TF8x, TZ8x).

The TK85-AX, is clearly marked with a sticker from the manufacturing source as "FOR LOADER USE ONLY". This unit has a weaker receiver floor spring which facilitates error free automatic cartridge load/unload in conjunction with the mechanics of the Loader.

The second variant is the TK85-BX which is STRICTLY for use in NON-Loader applications, i.e. Table top, and embedded in system cabs. The TK85-BX have a stronger receiver floor spring which prevent "leader unlatch" problems when a manual cartridge load/unload is initiated. The TK85-BX is specifically designed for use in conjunction with human operation of the drive's handle to load and unload cartridges from the tape drive without the potential for "leader unlatch" problems.

22.8.4 Power off with Tx857 loader swung out - Cartridge stuck

When a magazine is:
> removed from the TF857 cartridge loader
> the receiver is left in the open position,
> and loss of power/voltage occurs,
> then the receiver assembly door is closed,
> then the receiver will not reopen when the power is re-applied. (The Eject LED is Off)

To correct this condition you must slide the TF857 loader assembly to the service position then manually open the receiver assembly.

Always follow these 4 basic steps to avoid this condition.

1. Open receiver assembly.

2. Remove magazine.

3. Close receiver assembly.

4. Remove power if necessary.

22.8.5 Loader loading/unloading problems - TK85 Drive Rev C04

Intermittent load/unload problems have been identified with Tx857 loader assemblies causing fatal loader error "A8".

The problem is the TK85 drive assembly revision C04. TK86's are ok.

On Rev C04 the take up reel idle motor current is too low which causes too few tach pulses, when the cartridge is inserted. If the cart is inserted quickly, such as by hand, the cart will usually load with no problem. The problem has been resolved with a micro-code change to the TK85 tape drive assembly. Note that this firmware is on the drive and not the controller (see section later on). There is no way of upgrading the drive firmware, the drive itself must be replaced.

Rev levels TK85-AX Rev D03 and TK85-BX Rev D04 incorporate the fix. Previous versions to C04 also do not suffer from this problem.

22.8.6 Tx8x Head Cleaning Tape Notes

The user does not have to worry about when to clean the heads by using the head cleaning tape, because a light comes on on the front of the Tx8x7 and Tx8x to indicate this.

Operation/use of the tape drive will **not stop** when this light comes on.

On loader options the operator can then put the cleaning tape into a magazine or swing out the loader and put said tape direct into the drive.

There are different calabration tracks on the cleaning tape which the heads recognise and the drive then goes through its special head cleaning cycle.

22.8.7 Really old TK50 cartridges jam in TF857s

This is from a Software house, distributing software patches on old TK50 tapes.

In 1986 there was a modification to the plastic tape cartridge made by 3M to prevent the tapes jamming half in the drive. (This modification was to the move the ramp on the right side of the cartridge from the back to the front edge). This is the cause of the tape jam.

The following is is a way to recognise the tapes by the number on the bottom of the cartridge. :-

TK50-K   KBxxx xxxxx   No Known Problem

            92xxx xxxxx   No Known Problem

            83xxx xxxxx   Will Jam the TF857

Would you please get your customers to check the number of COMPACTAPE TK50 type, before installing in the loader.

22.8.8 TK85 Tape Leaders

30% of all TK85 tape drives returned for repair in 1992 had the leader broken or unlatched.

The following is a kit number for leader replacement on the TK85, it includes 5 leaders and gloves to be used when replacing the leader.

                  Part number   70-28824-01

This part number supersedes the original leader part number

22.8.9 TK85 Degaussing

The TK85 tapes cannot be degaussed like the TK50 and TK70, and it should not be attempted.

The magnetic field required to degauss TK85s is in excess of 1500 Oersteds which our degaussers cannot achieve (for TK50s it is 300), so there is a danger of leaving residual cal tracks and other nasty's if it is attempted.

22.8.10 TZ85/86 firmware V11 - Feb 93

Firmware V11 has been released for the TZ8x range of SCSI based cartridge tape drives, ie. TZ85, TZ86, TZ857, TZ867, TA857, TA867, SA100 and SA106.

This firmware fixes a problem with write protection when a tape is in the drive at power-up. It also fixes a problem where a tape gets "stuck" on the elevator of a loader. Refer to the release notes for further information.

22.8.11 TF85/86 and TF857/867 Firmware update procedure - Feb 93

There is a bug with version 4 firmware update procedure which can cause the parameters to change and therefore render the TF unavailable to the customer.

After updating the firmware of the TF85, TF857, TF86 or TF867 is it vital that you check that the parameters are still set correctly. **Before you start** the firmware update, list and record the CURRENT parameters (get a hard copy printout).

```
$ MCR SYSGEN CONNECT FYA0/NOADAPTER
$ SET HOST/DUP/SERVER=MSCP$DUP/TASK=PARAMS x    (x = NODENAME of TF)

PARAMS> SHOW /ALL
                 .
                 .
                 .
PARAMS> EXIT
```

If the firmware update is being done on a "live" system the drive should be "disconnected" from VMS/TMSCP by setting the TMSCP enable/disable switch on the TF's DSSI controller module to the disable position (S1-1 = ON (1)). Power off the drive before changing the switch setting. (S1 is the 4 position switch, S1-2 to S1-4 being used for DSSI ID)

Now do the firmware update.

After the firmware update show the parameters again. If any of the CURRENT values are different to the values recorded before you updated the firmware, you must set them to the "old" value.

For example

```
PARAMS> SET FORCENAME 0
PARAMS> SET NODENAME TAPE01
PARAMS> SET FORCEUNI 0
PARAMS> SET UNITNUM 16
PARAMS> SET SYSTEMID 3B5763CAAC76
PARAMS> WRITE   (saves the new parameters)
PARAMS> EXIT
```

If you are satisfied that the parameters are correct "reconnect" the drive to TMSCP by powering off and resetting S1-1 to OFF (0).

Now test the drive online using the operating system (eg. BACKUP). If everything is ok, then get a hard copy of the parameters and put a copy into the SMG.

22.8.12 TZ85 Firmware Ver 6 - Jun 92

V6_DEC Revision of Controller Firmware is available for the TZ85 Family (TZ85,TZ857,SA100,SZ100)

This firmware fixes the symptom where the tape drive hangs after reading a TK50 or TK70 tape. This happens with tapes that were written with a block size greater than 17K. Refer to the release notes for further information.

The code is image can be found at:
    ELWOOD::SCHOONER$PUBLIC:TZ85_V6_DEC.TZ_IMAGE

The code update procedure:
    ELWOOD::SCHOONER$PUBLIC:TZ85_FWU_PROCEDURE.PS (postscript format)
    ELWOOD::SCHOONER$PUBLIC:TZ85_FWU_PROCEDURE.TXT (text format)

The release notes:

   ELWOOD::SCHOONER$PUBLIC:TZ85_RELEASENOTES_V6_DEC.PS (postscript format)
   ELWOOD::SCHOONER$PUBLIC:TZ85_RELEASENOTES_V6_DEC.TXT (text format)

22.8.13 Tx8xx Timeouts loader to drive - Front Panel Err A4 and A8 - Nov 93

This is a loader problem of the DLT drives. If the drive is otherwise engaged when a cartridge is required to load then the loader will not load it but wait for it to become available. If the drive has an error this will be forever and the loader will eventually time out with these error codes on the front panel.

This naturally therefore only occurs on a second load or subsequent load, after the drive has faulted.

It will not report a drive fault.

This is misleading because it does not point the engineer at the drive but suggests the loader or controller is at fault.

If it is suspected that this is the case, look at the drive lights through the front panel for errors. The lights cannot be seen if there is a full magazine.

The loader fault codes include no provision for drive errors, so in the case of a drive error the loader can only show Timeouts, which for manual loads is all that VMS gets as well.

22.8.14 New version of TZ87x products - May 94

There is a new version of the TK87 that is cheaper but will not read TK50 or TK70 media.

There is no warning to the system that this restriction is the case. i.e. to the system they look like the pucker thing. So if a Compactape 1 or 2 is put in it will just return an error. The only indication to the engineer that the customer has one of these is the name on the front.

All Compactape 3 formats are read/writable.

The 2 products being sold by DECDirect at present in this category are

- TZ87N

- TZ877-NF

Digital Internal Use Only

22.9 TLZ04/06

22.9.1 60 and 90 metre tapes and compression mode

The TLZ06 supports 60 metre and 90 metre tape cartridges.

The TLZ04 only supports 60 metre tapes. 90 metre tapes do work, but the mechanism in the TLZ04 is not designed for such thin tapes and the tapes soon degrade and give lots of errors.

The TLZ06 offers a data compression mode which is controlled by software and allows for a greater amount of data storage per tape.

Tape Type	No Compression	Compression
TLZ04 (60 metre)	1.3 GB	Not supported
TLZ06 (60 metre)	1.3 GB	2.6 GB (typical)
TLZ04 (90 metre)		NOT SUPPORTED
TLZ06 (90 metre)	2.0 GB	4.0 GB (typical)

As normal for compression mode, figures for capacity cannot be guaranteed, it depends on how much compression can be achieved with the data, so only typical figures can be given.

The TLZ06 is compatible with its predecessor, the TLZ04, when using the 60 metre tape cartridge in non-compression mode.

22.9.2 TLZ04/06 supported configurations

The TLZ04/06 is supported by the KZQSA, which when installed in a BA440 the TLZ04/06 fits in the LH mass storage slot, and when in a BA213 the TLZ04/06 mounted in a separate expansion box.

The TLZ04/06 must be powered on before the system power is applied. This is because the KZQSA has no set ups for i.d.'s etc, it relies at power up on polling the SCSI to see whats there (or on a bus init). So what is not seen at power up never gets seen. This is typical of SCSI devices.

Table 22–22: Firmware Required to support the TLZ04

Model	ROM Revision
VS3100 Model 30 and 40	1.6 or greater
MV3100	1.6
VS3100 Model 38 and 48	1.5 or greater
VS3100 Model 76	All Revs support the TLZ04

The 2 ROMs to be replaced on a VS3100 are E21 and E23 on the system module, which are 40 pin ROMs.

The TLZ04/06 supports only Backup NOT Copy. It will do a copy but takes an inordinately long time, similar to an Exabyte.

22.9.3 TLZ Media, whose tapes are allowed?

All tapes for these drives should have the "Digital Data Storage" (DDS) logo on them, these are only marketed by Digital, and possibly SONY.
Digital Audio tapes are ***NOT*** acceptable and will only cause problems. .

90 metre DDS tapes should only be used in TLZ06's

22.9.4 TLZ04 Diagnostics

1. System Power-on test does a lot of testing to the TLZ04 (same as for any SCSI device).

2. The Customer System exerciser, Test 0, is available.

3. Customer Service System exerciser (T101, T102), with loopbacks in place, is available to put the drive through a more rigorous test. The exerciser is common to all SCSI devices. The exerciser first invokes the TLZ04 to run its Power-on testing taking roughly 30-60 seconds.

4. The second level then sends commands to the drive to invoke reads and writes (writes only with a write enabled tape). A scratch tape with the customer service key must be used, by running test 73 first. It is recommended to run the TLZ04 through at least one error free pass of the read/write diagnostics

5. MDM is supported on 130+

22.9.5 TLZ06-AA and TLZ06-BA - Differences - Dec 93

There are 2 versions of the TLZ06
The TLZ06-BA = TLZ06-AA + bracket to fit 5.25 inch space + plastic front cover
The TLZ06-AA = The 3.5 inch tape drive

Order the -BA when it is reqd for 5.25 inch applications
and the -AA when 3.5 inch applications.

It is easy to convert from one to the other if out of stock of the one reqd as below.

1. Remove from -BA variation 5.25 inch bracket (4 screws, easy access) and 5.25 inch plastic front cover (5 screws)

2. Remove the 3.5 inch plastic front cover from the defect -AA and fix onto the replacement -BA(this is now thus a -AA)

The reason to advise the field engineer to do this this change and not warehouse is that the warehouse does not have the plastic cover that fits the -AA variation. However the engineer does (on the defective drive).

22.9.6 Ejecting Cartridges - New Functionality

With TLZ04 Drive Rev A5 and later, new functionality has been added to the firmware to eject cartridges.

To eject a cartridge press and hold the eject button for 8 to 10 seconds, and unless the mechanism is broken the cartridge should eject.

Old drives sent for repair will be updated with this firmware.

Please inform customers of this option if fitting a TLZ04 Rev A5.

Some tape jams are due to loose tape within the tape cartridge. To avoid this type of tape jam, examine the tape through the plastic window, if loose tape is observed, tighten the tape by opening the access door and pressing down the two slots sliding open the access door and then rotating one of the reels to take up the slack. Dropping a cartridge can cause loose tape.

22.9.7 Boot Support for TLZ06 on VAX QBus Systems

The TLZ06 "BOOT" operation is NOT supported on the MicroVAX II, or any of the Qbus MicroVAX 3xxx systems. It will operate properly under VMS.

In order to support booting of the TLZ06-GA device on any of the Qbus VAX 4000-series systems, a minimum version of firmware is required (on the VAX):

22.9.7.1 VAX 4000, models 200 and 300

Console firmware V4.9 is required. Enter a SHOW VERSION command at the console prompt (i.e., >>>SHOW VERSION). The compatible CS revision of the CPU module is as follows:

```
KA660 @ CS minimum revision = E05 (for etch rev C1)
                              E06 (for etch rev C2)
KA670 @ CS minimum revision = F02
```

Order the new version of console firmware ROMs from Logistics. The following part numbers can be used:

SYSTEM TYPE	Hi BYTE	Lo BYTE
VAX 4000, model 200 Server	23-359E9-00 (E19)	23-358E9-00 (E6)
VAX 4000, model 200 Multi-user	23-357E9-00 (E19)	23-356E9-00 (E6)
VAX 4000, model 300 Server	23-355E9-00 (E17)	23-354E9-00 (E3)
VAX 4000, model 300 Multi-user	23-353E9-00 (E17)	23-352E9-00 (E3)

22.9.7.2 VAX 4000, models 500 and 600

Console firmware V4.8, or later, is required. Enter a SHOW VERSION command at the console prompt (i.e., >>>SHOW VERSION).

To obtain a copy of the file containing version 4.8 firmware for VAX 4000, models 500 and 600, contact the CSC (Customer Support Centre). The firmware in these systems is upgradable by either booting over the Ethernet or booting a magtape such as a TK70. The process detailing this operation is documented in the KA675/KA680/KA690 Maintenance Guide.

22.9.7.3 VAX 4000 model 100 and 400

These are shipped with console firmware which includes support for booting the TLZ06-GA option. No update is required.

22.9.8 TLZ06 support on DECStations - Mar 93

22.9.8.1 DECStation and DECSystem TLZ06 Firm Ware

For the TLZ06 to work on a DECStation properly it needs F/W Rev 3.89-19 which comes with TLZ06 Rev A02.

22.9.8.2 DECStation and DECSystem TZ30 and TLZ06 Interaction

Put them on different SCSI buses if possible.

22.9.8.3 DECStation and DECSystem hanging with TLZ06 in use

This is a SCSI CAM problem (The software that handles the PMAZ turbochannel SCSI) ???

22.9.8.4 VAX 4000-100 reboot problem with TLZ06

From John Northam, PTG

The TLZ06 tape drive may be seen as a DKxxx device instead of a MKxxx device, after a reboot of the system. The problem lies in the TLZ06 firmware. The firmware can be checked by doing >>>SHOW SCSI /FULL

If the tape drive is not accessed while VMS is up, a REBOOT will not result in the drive being seen as a DKxxx. The problem occurs when the drive is accessed in any way such as MOUNT, or INIT.

The TLZ06 will not show the problem if it shares the same SCSI bus with a SCSI disk drive. The SCSI disk causes several SCSI BUS RESETS during VMS REBOOTs, thereby resetting the TLZ06 to asynchronous mode prior to the SCSI INQUIRY command.

An explanation is as follows. During and after being accessed, the drive is in SYNChronous mode. During the VMS REBOOT, the drive does not go back to ASYNC but remains in SYNC mode, so that when VMS goes out to perform the INQUIRY after REBOOT, the drive begins to translate its IDENT information SYNChronously. VMS does not interpret the INQUIRY data in SYNC mode and therefore, initiates a SCSI BUS RESET.

The SCSI BUS RESET causes the TLZ06 to default back to ASYNC mode, but it does not begin the transfer of its ID bytes with byte 0 as it should have; rather, it transfers where it left off before the SCSI BUS RESET, with byte 16 hex. Byte 16 interprets as a RANDOM ACCESS device, and therefore, DKxxx.

Instal a new version of microcode (V435), from a special firmware update tape, which is now available from the PTG (John Northam). Or put the TLZ06 on a SCSI with disk drives.

22.9.9 TLZ06 - Do not use $ INIT/ERASE

INIT/ERASE with a 90 metre cassette (this is the normal for a TLZ06, the TLZ04 uses 60 metre) will time out and fail.

Do not attempt to use the /ERASE qualifier with INIT. A tape will be logically erased using a straight INIT command with no qualifiers. Relabeling a tape will also logically erase the tape and use the new label. There is a patch kit available for OpenVMS V5.5 thru V5.5-2 only.

There is new TLZ06 f/w available on tape and updated independantly of the host. I do not know if that fixes this problem.

22.9.10 TLZ04 Tape Stuck in Drive Procedure

If a tape does get stuck in a drive then firstly try powering it up unattached to any bus and then press the unload button once the two green lights come on. If this fails remove it manually by carrying out the following.

a. Remove the TLZ04-AA unit from its box (Whatever it maybe).

b. Remove the top lid of the unit and gain access to the tape deck.

c. On the left hand side you should see a black square of plastic stuck over a hole. Remove and keep it.

d. Through the hole you should now see a plastic cog. Turn this and you will manually crank the tape loading mechanism.

e. Work the mechanism until the tape cartridge is clear of the capstan but not entirely out of the unit.

f. Ensure the tape is coming out free from obstruction by unhooking it from any part of the mechanism that is retaining it.

g. Now work the mechanism until the tape comes free of the unit.

h. Throw away the tape UNLESS YOU ARE SURE it is completely undamaged.

I do not believe there is a manual unload procedure for the TLZ06.

Tapes can become jammed if there is a slack loop of tape in the cartridge at load time. To ensure there is not then new tapes should be pre-tensioned before use by opening up the sliding cover and the top cover. The latter frees the hub brakes and will permit the tape to be tensioned. Tension by winding the take up reel so that the tape is at the end

22.10 TZK10

22.10.1 The TZK10 - an overview

This is a "QIC" tape product, (as is the TK25) for workstation/desktop, it is mainly for PCs using ULTRIX and MSDOS, the Micros space will mostly see the TLZ04. It will also do transaction logging as well as the usual activities.

It has the following attributes.

1. Half Height 5 1/4 form factor

2. Storage 325 Mbyte (600 foot tape) or 525 Mbyte (1000 foot tape) depending on the cartridge used.

3. Uses the industry standard DC63xx tape cartridge (1/4 inch tape)

4. It is a SCSI device

5. Various densities depending on a jumper on the rear of the unit.

6. A transfer speed of approx 200 K bits per second.

Table 22–23: RSL

Digital p/n	Description
TZK10-AA	Tape Drive
TZK1x-CB	Pack of 5 Tape Cartridges 320 Mbytes/ 600 foot
TZK1x-CD	Pack of 5 Tape Cartridges 525 Mbytes/ 1000 foot
TZK1x-HA	Pack of 10 Cleaning Cartridges

Digital Internal Use Only

22.11 Diagnostics for Tapes

22.11.1 VAX diagnostics

Table 22–24: VAX diagnostics

Drive	Diagnostics
TE16	EVMAA, EVMAB and EVMAC
TS05	EVMAF thru EVMAJ
TS11	EVMAA and EVMAD
TU45	EVMAA, EVMAB and EVMAC
TU77	EVMAA, EVMAB and EVMAC
TU78	EVMAA and EVMAE
TU79	EVMAA and EVMAE
TU80	EVMAA, EVMBD and EVMBE
TU81	EVMBA and EVMBB

For the DSA tape drives (TAxx) use ILEXER and ILTAPE, which can only be run from the HSC50/HSC70.

22.11.1.1 EVMAA

22.11.1.1.1 Sections

1. Qualification test (TM03 - TE16, TU45 and TU77)

2. Qualification test (TS11, TU80, TU78 and TU79)

3. Data reliability test

4. Multi-drive test

5. Conversation mode test

6. TU80 streaming test

22.11.1.1.2 Event flags

- EVE 1 Inhibit error retries

- EVE 2 Put errors into system errorlog

- EVE 3 Prompt for change of number of records for multi-drive test

- EVE 4 Suppress TU78/TU79 soft error printout

- EVE 5 Lock TU80 streaming test into high speed mode

22.11.1.1.3 Conversation mode

If you wish to troubleshoot a tape drive using an online test then using CONVERSATION MODE is ideal. This will enable you to get the drive to do one (or just a few) function(s) repetitively and this makes scoping much easier.

After starting (RUN EVMAA/SEC:CON or START/SEC:CON) the diagnostic asks a few questions which are fairly self explanatory. By answering these questions you can select which density, parity, block size and pattern you require.

Pattern 1 is all one's, pattern 2 is all zero's and pattern 12 is random data.

You will then be asked to enter the functions you want the drive to perform. If an exclamation mark (!) is placed after a function that function will only be performed once.

If you SET FLAG IE1 the error printout will be inhibited.

Table 22-25: Common function codes for conversation mode

Code	Function performed
NOP	Performs no device operation but does access device registers.
DRCL	Performs a drive clear operation.
REW	Rewind.
WTM	Write a tape mark.
ERA	Erase (write an extended interrecord gap.)
WRT	Write a record.
RD	Read a record forwards.
RDR	Read a record reverse.
END	END code needed to terminate the function inputing.

As an example, if you wanted to write a record, read that record in reverse, then read it forwards and repeat this procedure all the way down the tape (or until ^C) you would enter the following functions. Note that a rewind is issued first and that the rewind will only be done once. Typing END starts the execution of the routine.

```
REW!        ; Rewind (but do it only once)
WRT         ; Write record
RDR         ; Read record in reverse
RD          ; Read record forwards
END         ; End of function inputing, start execution
```

22.11.1.2 EVMAE

When EVMAE is run its loads microcode into the TM78. The microcode is not kept within EVMAE but in a separate file called KKTMAC.PAK. Before you run EVMAE make sure that the file KKTMAC.PAK is also on the load device.

To test the TM78 through PORT B, set EVENT FLAG 1.

22.11.2 ILEXER

ILEXER prints out a summary as it is running. Table 22-26 shows what the various types of errors mean.

Table 22-26: ILEXER error information

Error type	Meaning
Hard	Unrecoverable error.
Media	Write succeeded when retried on different spot on the tape, therefore the media was probably at fault.
Double trkerr	Data errors occured in two tracks during a read forwards, but were corrected by the formatter.
Double trkrev	As above, but read reverse.
Single trkerr	Data error occured in one track during a read forwards, but was corrected by the formatter.
Single trkrev	As above, but read reverse.
Other err A	Read or read reverse successful but with AMTIE or PHTIE flagged.
Other err B	Status, read or read reverse successful after retries.
Other err C	Write retry succeeded on the same spot on the tape that the previous write had failed on.

There should be no HARD errors logged. For a 15 minute run on a good drive with good media there should be no more than 20 media errors. There should be no OTHER ERR B errors, and less than 10 OTHER ERR C errors. If there are only one or two of the remaining errors the

drive is probably ok, but each case must be considered individually depending on the reasons why ILEXER is being run in the first place.

22.11.3 PDP11 diagnostics

Table 22–27: PDP11 diagnostics

Drive	Diagnostics	Utility driver
TE10	ZTMA, ZTME, ZTMF and ZTMH	ZTMG
TE16/TM02	ZTUA, ZTUB, ZTUC and ZTUG	ZTUE
TE16/TM03	ZTEA, ZTEB, ZTEC, ZTED and ZTEE	ZTEF
TS11	ZTSH and ZTSI	
TSU05	ZTSA, ZTSB, ZTSC and ZTSD	
TSV05	VTSA, VTSB, VTSC, VTSD and VTSE	
TU45/TM02	ZTUI, ZTUJ, ZTUK and ZTUL	ZTUE
TU45/TM03	ZTUO, ZTUP, ZTUQ and ZTUR	ZTUT
TU77	ZTEA, ZTEB, ZTEC, ZTED and ZTEE	ZTEF
TU80	ZTUV, ZTUW, ZTUX, ZTUY and ZTUZ	
TU81	ZTU1 AND ZTU2	

22.11.3.1 Data reliability tests

The data reliability diagnostics ZTED, ZTUA, ZTUI, ZTUR and ZTMH do not test the drive out thoroughly if run in the default mode. To test the drive more thoroughly set switch register switches 6, 7 and 8 (ie. SWR = 700).

22.11.3.2 Utility driver

One of the most useful diagnostics for troubleshooting broken magtape subsystems on a PDP11 is the UTILITY DRIVER (sometimes known as Brutis). This diagnostic does not check for errors but carries on trying to use the drive regardless of whether the drive is working or not. There are a number of different diagnostics for the different types of drives but they are all very similar. There no utility drivers for the newer types of drives.

Table 22–28: Utility drivers ZTEF, ZTUE and ZTUT

Memory address	Parameter	Default value	Comment
600	RH address	172440	Unibus address of tape subsystem
700	Drive number	0	TM02/03 unit number, 0-7
702	Unit description	2300	Density, format and slave number
704	Frame count	177760	Character count in 2's complement
706	Word count	177770	Word count in 2's complement
710	Read address	4000	Address of read buffer
712	Write address	5000	Address of write buffer
714	Ready delay	100000	
716	Ready multiplier	1	
720	Operation delay	10000	
722	Operation multi	1	
724	Number of operations	1	Number of functions required
740	Operation table	60	Start of required functions
742	Next operation	0	Next function required, and so on thru to 770

The default parameters in Table 22–28 forces drive 0, slave 0 to write 16 character records (all 1's data) in 1600 PE mode continuously down the tape. If you wish to change any of the parameters you can do so by changing the contents of the relevant memory location.

For example, if you wanted to change the the density or the slave number you would change the contents of memory address 702.

- Bits 0-2 = slave number
- Bit 3 = parity (0 = odd parity)
- Bits 4-7 = format
- Bits 8-10 = density
- Examples :-
- 2300 = PE, normal format, slave 0
- 1300 = NRZI, normal format, slave 0
- 2301 = PE, normal format, slave 1
- 1302 = NRZI, normal format, slave 2

The operation table starts at memory address 740. You must tell the diagnostic how many operations you wish to use from the operation table by changing the contents of memory address 724.

Table 22-29: ZTEF, ZTUE and ZTUT function codes

02	rewind off-line
06	rewind
10	drive clear
24	erase
26	write tape mark
30	space forward
32	space reverse
50	write check forward
56	write check reverse
60	write
70	read forward
76	read reverse

For any TM11, TMA11 or TMB11 drive use ZTMG.

Table 22–30: Utility driver ZTMG

Memory address	Parameter	Default value	Comment
600	Device address	172520	Address of tape controller
700	Unit description	60000	Density, parity and unit number
702	Byte count	177760	Character count in 2's complement
704	Read address	3000	Address of read buffer
706	Write address	2000	Address of write buffer
710	Space count	177777	Space count in 2's complement
712	Ready delay	100000	
714	Ready multiplier	1	
716	Operation delay	10000	
720	Operation multi	1	
722	Number of operations	1	Number of functions required
724	Operation table	2	Start of required functions
726	Next operation	0	Next function required, and so on thru to 754

The default parameters in Table 22–30 forces unit 0 to write 16 character records (all 1's data) in 9 track, 800bpi NRZI with odd parity on unit 0.

Table 22–31: ZTMG function codes

1	Read
2	Write
3	Write tape mark
4	Space forward
5	Space reverse
6	Write with extended IRG
7	rewind

22.12 Tape Tips

This is a list of various bits of tape information which have appeared previously as fact-flashes and don't relate to a specific section of this chapter.

22.12.1 TU45 Load problems

- If you are experiencing loading problems check that the vacuum belt is clean and tight. Adjusting the vacuum to an out of spec value is not a solution. The vacuum should be set to 18.5 inches. If the drive fails to load with the vacuum set correctly it might be due to the belt slipping.

Options Affected: TSZ05
Submitted By: Brian Hailstone
Date: 7-MAY-1993
Filing Instructions: File at the back of the tapes chapter

TSZ05 firmware for multiple LUN fix

Problem.
From the console prompt on some systems, multiple logical units (LUNS) may appear when doing a SHOW DEVICE. This may prevent a auto boot from working. This does not effect how the tape drive operates under the operating system.

Solution.
Two EPROMs on the main circuit board need to be replaced (ie. new firmware). Check to see if U13E and U7C_B are part numbers 966635-004 and 966192-002. If they are not, the new firmware has not been installed.
The firmware kit (2 EPROMs) is part number 22-11965-01 and is classified as a product enhancement and not an FCO (ie. it cost us money).
Only install this firmware if the specific multiple LUN problem exists.